



A Leader in
Level Measurement

For Assistance Call 1-800-527-6297
Outside North America + 215-674-1234

Installation and Operating Instructions

USonic™ Series
Continuous Ultrasonic Level
Transmitter using US-XX Series
Electronics

U.S. and Canada:	1-800-553-9092
24-Hour Service:	1-800-527-6297
International:	+1 215-674-1234
Fax:	+1 215-674-2731
E-mail:	drexelbrook.service@ametek.com
Website:	www.drexelbrook.com

AMETEK Drexelbrook makes no warranty of any kind with regard to the material contained in this manual, including, but not limited to, implied warranties or fitness for a particular purpose. Drexelbrook shall not be liable for errors contained herein or for incidental or consequential damages in connection with the performance or use of material.

EDO# 5-13-103
US-XX-LM
Issue #10

USonic™ Series

Continuous Ultrasonic Level Transmitter

using US-XX Series Electronics



Table of Contents

Glossary of Terms	vi
Quick Start Menu.....	viii
Section 1: Introduction.....	1
1.1 Product Description	1
1.2 Models Available	1
1.3 Approvals: (See Section: 6.4 for Details)	1
1.4 System Specifications:.....	2
1.5 Definition of Terms	2
1.6 Types of Output.....	3
1.7 Types of Flumes and Weirs	4
Section 2: Installation.....	11
2.1 Unpacking	11
2.2 Mounting the Transmitter	11
2.3 Wiring the Transmitter	13
2.4 Installation Examples.....	14
Section 3: Configuration	17
3.1 System Configuration with Display / Keypad	17
3.2 Configuration Menu.....	18
3.3 Menu Functions	18
3.4 Error Messages	24
3.5 Menu / Display Abbreviations.....	24
Section 4: Troubleshooting.....	25
4.1 Troubleshooting Procedures	25
4.2 Optimized Field Calibration.....	26
4.3 Troubleshooting the Loop Connections.....	26
4.4 Diagnostic Messages.....	27
4.5 Telephone Assistance.....	28
4.6 Equipment Return / Warranty	28
4.7 Field Service	29
Section 5: Configuration and Calibration With HARTWin™	31
5.1 General Description	31
5.2 Model Number	31
5.3 System Requirements	31
5.4 Installing The RS232 Modem.....	32
5.5 Installing The USB Modem	33
5.6 Install the Windows Version HARTWin™ Software on Hard Drive.....	34
5.7 Description of Function Keys	35
5.8 Configuration	36
Section 6: System Specifications	51
6.1 Transmitter Specifications.....	51
6.2 Transducer Specifications.....	52
6.3 Enclosure Specifications.....	52
6.4 Approvals	52
Section 7: Control Drawings / General Safety Information.....	55
7.1 General Safety Information	55
7.2 FM Control Drawings	57
7.3 FMc Control Drawings	60
7.4 ATEX Control Drawings	63

Glossary of Terms

Distance	The measured distance from the sensor face to the target.
Distance Mode	Output signal increases as the distance increases (reverse acting output)
Distance to Zero Flow	This is the “No Flow” condition in a flume or weir. It may be to the bottom of the flume/weir, or depending on the type of flume/weir the “no flow” condition may be above the bottom of the flume/weir, with standing water below this point.
Fault Indication	Output goes to 3.7 mA or 22 mA (user selectable in configuration menu) during a fault condition such as Lost Echo or Near Zone. See Error Messages section
Flow Mode	Output increases as level (head height) increases. Output is non-linear with level and is based on Flume/Weir primary element characterization, or strapping table
Flow rate	The instantaneous flow rate measured in flow mode of operation.
Flume Size	A selection of the various throat sizes of specific flume and weir tables contained in the pre-programmed software.
Flume Type	A selection of the specific flume and weir types that have been pre-programmed in the software.
Gain Adjustment	The USonic’s default gain setting is with SmartGain™, abbreviated a “HD” in the software code. Other gain settings are available for use in abnormal application requirements. Contact the factory before changing from “HD” mode.
HD Adjustments	SmartGain™(sometimes seem abbreviated as “HD”) provides an algorithm that permits the system to ignore most internal obstructions that are inside of the ultrasonic beam path. Changing an “HD” setting will allow this same algorithm to be used at different power settings. Consult factory before changing HD Adjustments.
Head Units	In Flow configuration the level measurement (bottom of flume/weir to surface of level) is referred to a head height. Enter the units in flow rate that will be used, GPM (Gallons per minute), MGD (Million Gallons per Day), M3/Hr (Cubic Meters per Hour, Litres per Second, Litres per Minute)
Input Type	Allows the selection of Level, Distance, Volume or Flow. Based on user input type selection, the USonic menu items will only allow data entry in valid, related menus. I.e.: If Level is selected, menu’s for distance, volume and flow are locked out.
Level	The measured distance from the sensor face to the target minus the tank height. Or, the distance from the tank bottom to the liquid surface.
Level Mode	Output signal increases as the level increases (direct acting output)
Lost Echo	A condition that occurs when the ultrasonic transmission does not return to the sensor. This could be due to foam, irregular surface, dished tank bottom, etc.
LRV	(Lower Range Value) The point at which the output signal is equal to 4 mA (0%). Also see Zero.

Glossary of Terms

Max Flow	This is the maximum flow rate that is expected in a specific flume or weir. This is not necessarily the maximum flow that the flume/weir is capable of producing.
Maximum Capacity	Used in level to volume conversions, the maximum capacity of the vessel at a known maximum level point.
Near Zone	The distance below the sensor where the measurement cannot be made (12 inches/305 mm)
Range	The maximum distance measurable from the sensor face
Range of Percent	The percentage of level or distance between the LRV (4 mA, 0%) point and the URV (20 mA, 100%), always enabled on the display.
Repetition Rate	This is the number of milliseconds that elapses between ultrasonic pulse transmissions. Longer repetition rates may be helpful if there are multiples reflections that are being picked up or if lost echoes are encountered due to intermittent presence of foam or agitator blades. Consult Factory before changing this parameter.
Sensor Offset	Used to tell the transmitter the amount of distance above or below the tank height that the sensor is mounted in order to calculate the tank volume.
Span	The point in the vessel where the output signal is equal to 20 mA (100%). Also see URV
Strapping Table	Correlates Level information to Volume information. A 21-point table that can be customized to accommodate an irregular shaped vessel, flume or weir. Information is entered as a Level “in” point vs. a Volume “out” point for all 21 possible points.
Tank Height	This is the measurement from the Tank Bottom to the face of the sensor.
Time Delay	Time delay allows signal averaging over the specified duration (0-90 seconds). Useful if wave action causes the output signal to be too “jumpy” for control / indication use.
Totalizer reset	The USonic has two totalizers, one that is a permanent record of the total volume that has been measured and a second totalizer that can be reset to zero by the user. The Reset Totalize can be reset to zero in the configuration software to allow the user to take periodic measurements from a reference point in time.
Totalizer Scale	The totalizer keeps record of the total volume that has passed through the flume/weir. In large flumes & weirs multipliers annotate this total volume. Each “count” on the totalizer can be representative of an exponential volume of water (X-1, X-10, X-1M, X-100, X-1,000, X-10,000 or X-100,000 can be selected)
URV	(Upper Range Value) The point at which the output signal is equal to 20 mA (100%). Also see Span.
Volume	The level of the liquid in the vessel converted to volume based on tank strapping tables,
Zero	The point in the vessel where the output signal is equal to 4 mA (0%). Also see LRV.

Quick Start Menu

Menu Navigation:

1. Hold ENTER Button 5 seconds to access configuration menu.
2. Use UP & DOWN buttons to select menu items
3. Press ENTER button to change selected items
4. Hold ENTER button to go to previous menu or continue to hold to return to operate mode.
5. Press UP & DOWN buttons simultaneously to force target acquisition.



1.00	Input Type	Select Application Type
1.01	Type	Level / Distance / Volume / Flow
2.00	Level	Enabled Only When Level Selected
2.01	Units	Inches / Feet / Meters / Centimeters / Millimeters
2.02	Tank Height	User Defined Numeric Value
2.03	Sensor Offset	User Defined Numeric Value
2.04	LRV	User Defined Numeric Value
2.05	URV	User Defined Numeric Value
3.00	Distance	Enabled Only When Distance Selected
3.01	Units	Inches / Feet / Meters / Centimeters / Millimeters
3.02	LRV	User Defined Numeric Value
3.03	URV	User Defined Numeric Value
4.00	Volume	Enabled Only When Volume Selected
4.01	Level Units	Inches / Feet / Meters / Centimeters / Millimeters
4.02	Tank Height	User Defined Numeric Value
4.03	Sensor Offset	User Defined Numeric Value
4.04	Vessel Type	Vertical / Hor Cyl Flat / Hor Cyl Dished / Hor Cyl Hemi / Sphere / Custom
4.05	Load Standard Table	Vertical / Hor Cyl Flat / Hor Cyl Dished / Hor Cyl Hemi / Sphere
4.06	Vessel Units	Gallons / M3 / Liters / Barrels / Imperial Gallons
4.07	Max Capacity	User Defined Numeric Value
4.08	LRV	User Defined Numeric Value
4.09	URV	User Defined Numeric Value
5.00	Flow	Enabled Only When Flow Selected
5.01	Flume Type	Parshall / Palmer Bowlus / Trapezoidal Flume / Rect Weir W/ End Contr. / Rect Weir W/o End Contr. / Trapezoidal Weir / V-Notch Weir / Custom / H-Flume / Leopold Lageo
5.02	Flume Size	Code from Table / or / Numeric Value
5.03	Flow Units	GPG/ MGD / M3/HR / LPS / LPM
5.04	Max Flow	User Defined Numeric Value

Quick Start Menu

5.05	Head Units	Inches / Feet / Meters / Centimeters / Millimeters
5.06	Distance to Zero	User Defined Numeric Value
5.07	Sensor Offset	User Defined Numeric Value (Used Only With Custom Flumes)
5.08	Totalizer Scale	X1 / X10 / X100 / X1k / X10k / X100k / X1Mil
5.09	Reset Totalizer?	No / Yes
6.00	Strapping Table	Enabled When Volume or Flow Selected
6.01	Max Points	0...21
6.02	In Point 1	User Defined Numeric Value
6.03	Out Point 1	User Defined Numeric Value
6.04-6.43	In / Out Points	User Defined Numeric Value
7.00	System Settings	
7.01	Temperature Units	F / C
7.02	Gain Adjustment	Hd / Hd High / 100% / 84% / 67% / 50% / 32% / 17% / 8%
7.03	HD Adjustment	Numeric Value (Consult Factory)
7.04	Rep Rate	300ms / 700ms / 1100 ms / 1500ms
7.05	Echoes	1-10 Consult Factory
7.06	Damping Time	User Defined Numeric Value
7.07	Near Zone Fault	High / Low
7.08	Lost Echo Fault	High / Low / LST VAL
7.09	Lock Ma Output	User Defined Numeric Value
7.10	Trim 4ma	User Defined Numeric Value
7.11	Trim 20ma	User Defined Numeric Value
7.12	Hart Mode	Normal / DCS (X100)
7.13	Polling Address	0...15
7.14	Restore Factory Defaults?	No / Yes
7.15	Password	Edit Password
7.16	Password Enabled?	No / Yes
7.17	Contrast	0...10...50
7.18	Low Offset	User Defined Numeric Value, Consult Factory
7.19	High Offset	User Defined Numeric Value, Consult Factory
7.20	Pipe Length	User Defined Numeric Value
7.21	Pipe Diameter	User Defined Numeric Value
8.00	Display	
8.01	Toggle?	No / Yes
8.02	Level	Enable / Disable
8.03	Distance	Enable / Disable
8.04	Volume	Enable / Disable
8.05	Flow	Enable / Disable
8.06	Total	Enable / Disable
8.07	Resettable Total	Enable / Disable
8.08	mA Output	Enable / Disable
8.09	Temperature	Enable / Disable
9.00	Calibration	
9.01	Point Calibration	Enter Distance To Product

Quick Start Menu**PRIMARY DEVICE CODES**

TRAPEZOIDAL FLUME	
CODE	SIZE
1	SMALL 60 DEG16
2	LARGE 60 DEG
3	X-LARGE 60 DEG
4	3 FT 60 DEG
5	2 IN 45 DEG WSC
6	12 IN 45 DEG SRCRC
7	24 SRCRC

PALMER BOWLUS	
CODE	SIZE (IN)
1	4
2	6
3	8
4	10
5	12
6	15
7	18
8	21
9	24
10	27
11	30

PARSHALL	
CODE	THROAT (IN)
1	1
2	2
3	3
4	6
5	9
6	12
7	18
8	24
9	36
10	48
11	60
12	72
13	96

H - FLUME	
CODE	SIZE (IN)
1	6
2	9
3	12
4	18
5	24
6	30
7	36
8	54

V-NOTCH WEIR	
CODE	SIZE
1	22.5 DEG
2	30 DEG
3	45 DEG
4	60 DEG
5	90 DEG
6	120 DEG

Rectangular Weir - with or without End Contractions: Enter Crest Length

Trapezoidal Weir: Enter Crest Length

Leopold Lagco Flume: Enter Flume Size

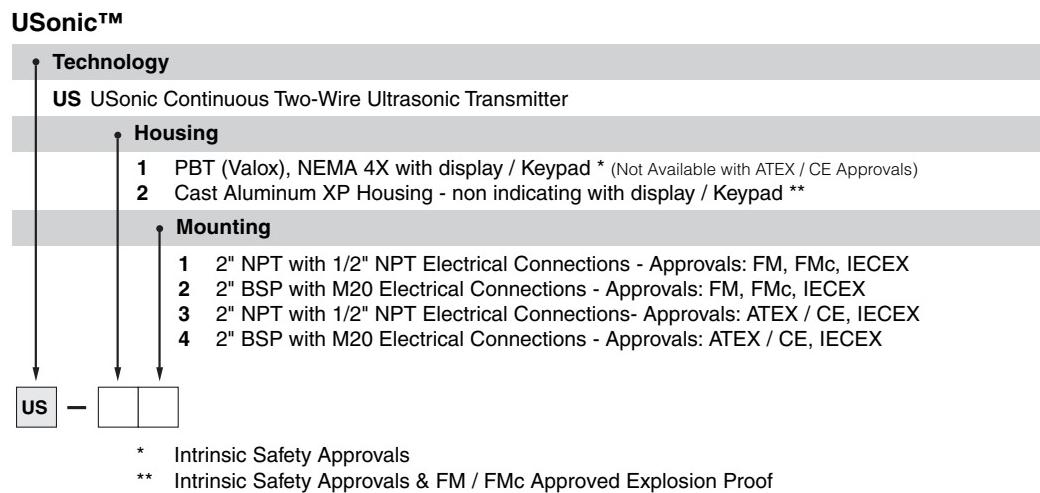
Section 1: Introduction

1.1 Product Description

The AMETEK Drexelbrook® USonic™ Series instrument is a Two-Wire (Integral) assembly. Using ultrasonic technology, the USonic™ continuously and accurately measures **Level** up to a range of 30 feet, or **Open Channel Flow**. The measurement output is a 4-20 mA current signal or HART® digital communications.

The Ultrasonic sensor is made of CPVC for compatibility with a wide range of process materials.

1.2 Models Available



1.3 Approvals: (See Section: 6.4 for Details)

FM, FMc, ATEX, IECEx

Intrinsically Safe for Class I, Div. 1, Zone 0, Zone 1 hazardous locations.

Cast Aluminum Housing versions:

FM Explosion Proof for Class I, Div. 1 hazardous locations.

1.4 System Specifications:

- **Power:** 19 to 30 Vdc
- **Output:** 2-Wire, 4-20 mA, HART
- **Sensor:** 6.5" CPVC sensor rated: -40°F to +160°F (-40°C to +71°C)
- **Sensor Mounting:** 2" NPT or 2" BSP, CPVC
- **Display Option:** 2-Line, 7 digit LCD
- **Software:** Level, Distance, Volume, Flow rate via user selectable Flume and Weir characterizations or 21-Point strapping table, Totalization via 1 resettable and 1 non-resettable totalizer.

1.5 Definition of Terms

Zero: (LRV)

The point at which the output signal is equal to 4 mA (0%)

Span: (URV)

The point at which the output signal is equal to 20 mA (100%)

Range:

The Maximum distance measurable from the transducer face.

Near Zone:

The distance just below the transducer face where the transmitter cannot make a level measurement (12 inches / 305 mm).

Lost Echo:

A condition that occurs when the ultrasonic energy is not being returned to the transducer. For example, a loss of echo may occur when large amounts of foam are present.

Strapping Table:

Displays the value of the input to level and output to volume in percent in a 21-Point table. This also allows points to be changed to accommodate irregular shaped vessels and custom flume or weir characterizations.

1.5 Definition of Terms (Continued)

Sensor Offset:

Sensor Offset is used to tell the transmitter the amount of distance above or below the top of the tank that the transducer face is located in order to calculate the tank volume. Sensor Offset can be applied in cases where:

- The transducer protrudes below the top of the tank, or
- The transducer is mounted above the top of the tank, or
- A pipe extension is installed to raise the transducer face 12 inches above the tank height to compensate for the 12-Inch Near Zone.

See Section 5.8.1.

1.6 Types of Output

Level Mode:

Output increases as the internal level of the vessel increases.

Level output is the most common type of output measurement.

Configuration is referenced from the bottom of the vessel.

Distance Mode:

Output increases as the distance increases away from the transducer.

Configuration is referenced from the Transducer Face.

Flow Mode:

Output increases as head height level increases (increasing flow rate). Output is non-linear with level changes and is based on the flow characteristic of a selected Flume, Weir, or strapping table for a custom primary flow device.

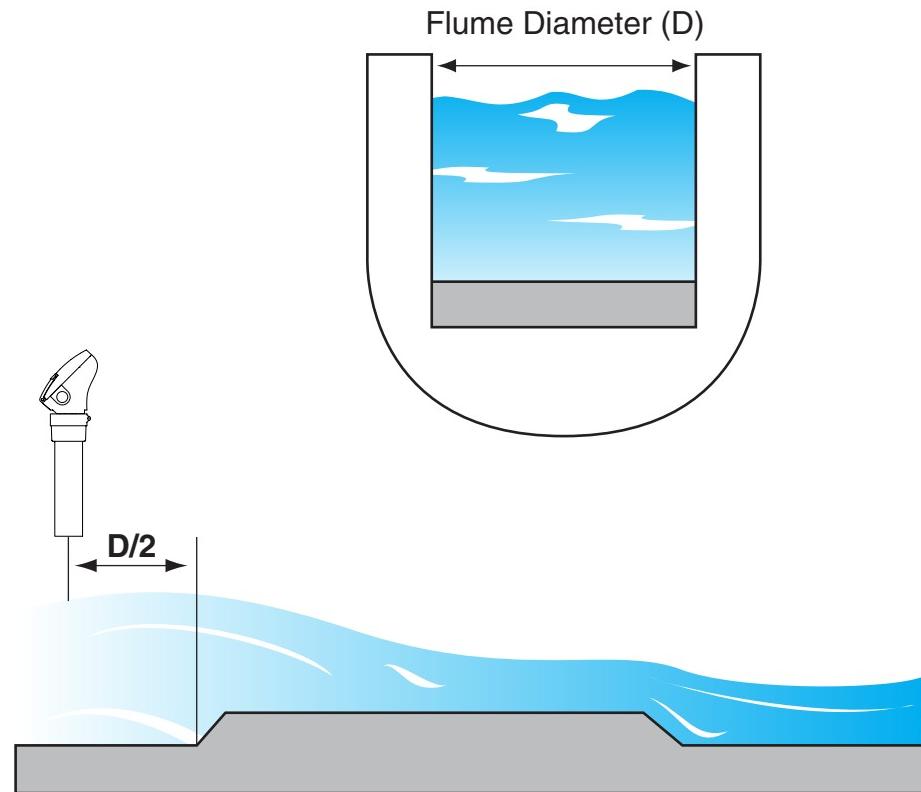
Fault Indication:

Output goes to 3.7 or 22 mA (user selectable) during a fault condition such as Lost Echo or Near Zone violations.

1.7 Types of Flumes and Weirs

The USonic™ Supports the Following Flumes and Weirs:

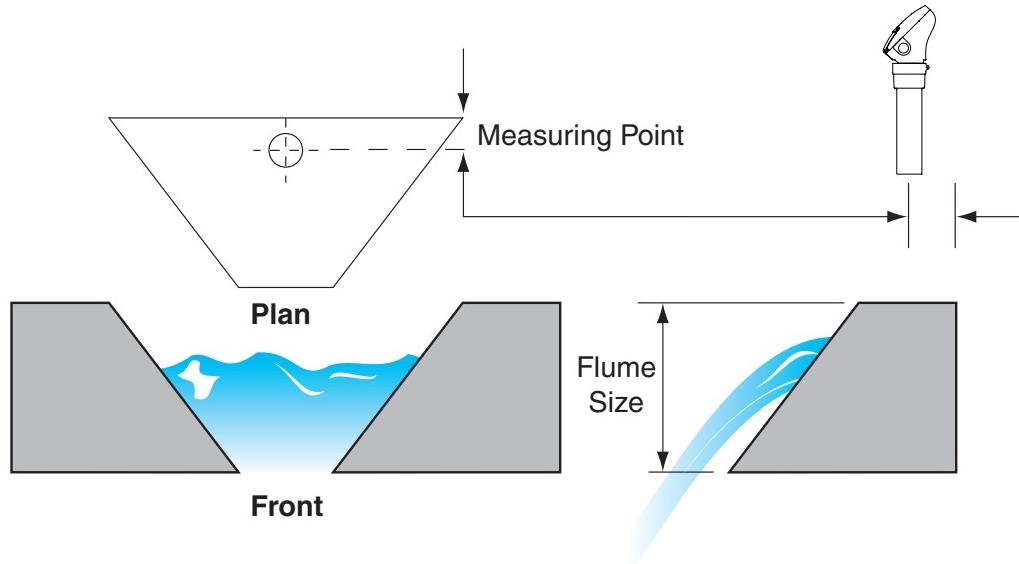
Leopold-Lagco Flumes (Variable Sizes):



1.7 Types of Flumes and Weirs (Continued)

“H” Flumes:

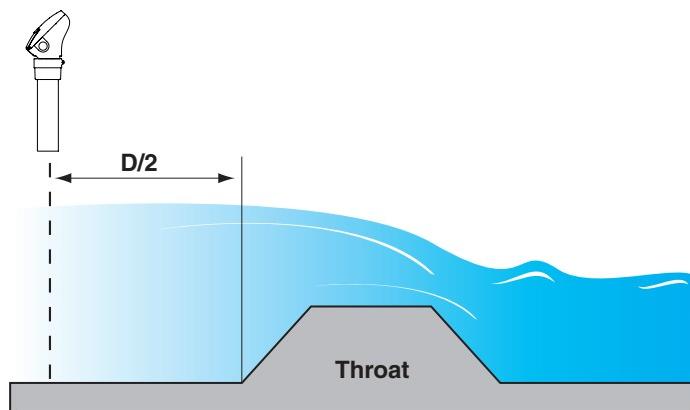
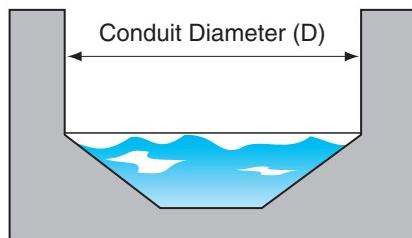
Code	Inches	Millimeters
1	6	152
2	9	229
3	12	305
4	18	457
5	24	610
6	30	762
7	36	914
8	54	1372



1.7 Types of Flumes and Weirs (Continued)

Palmer Bowlus Flumes:

Code	Inches	Millimeters
1	4	102
2	6	152
3	8	203
4	10	254
5	12	305
6	15	381
7	18	457
8	21	533
9	24	610
10	27	686
11	30	762

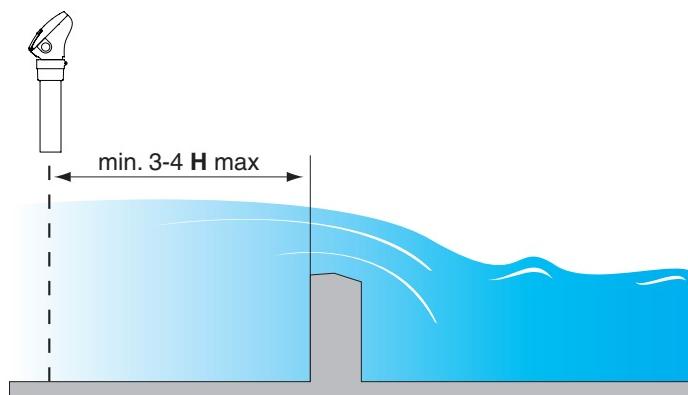
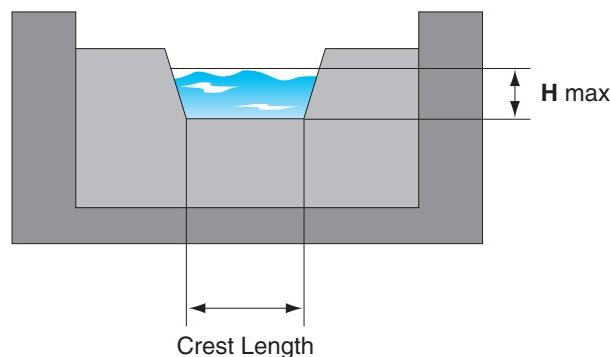


1.7 Types of Flumes and Weirs (Continued)

Trapezoidal (Cipolletti) Weir (Variable Sizes):

Trapezoidal (Cipolletti) Flume:

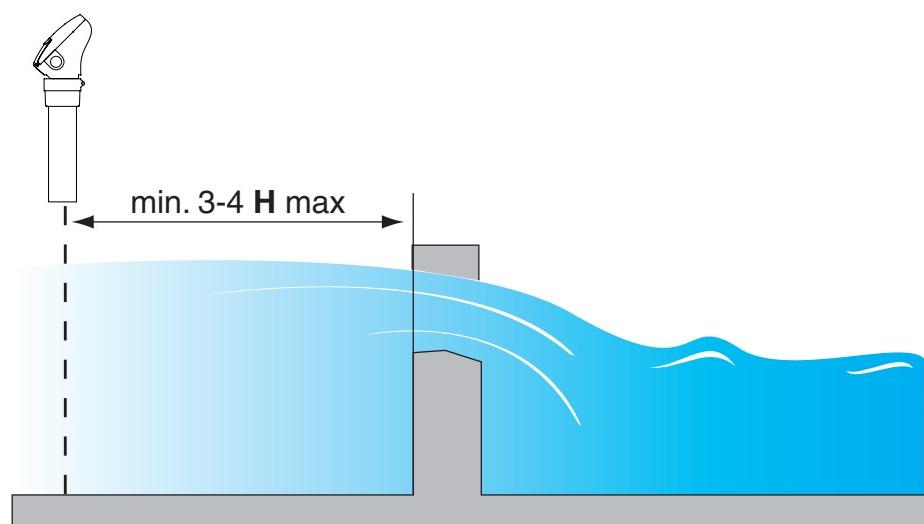
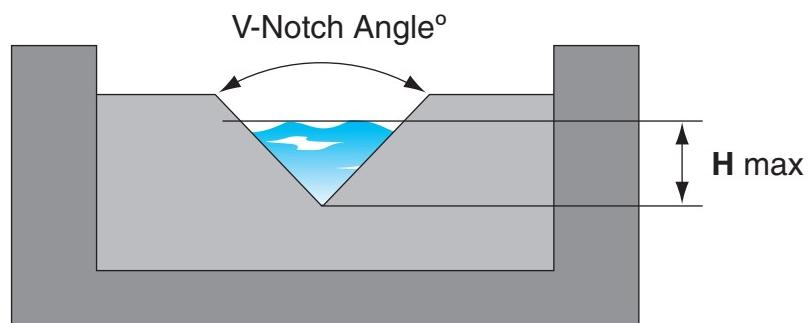
Code	Size
1	Small 60° V
2	Large 60° V
3	X Large 60° V
4	3 ft 60° V
5	2 in 45° WSC
6	12 in 45° SRCRC
7	24 in SRCRC



1.7 Types of Flumes and Weirs (Continued)

V-Notch Weirs:

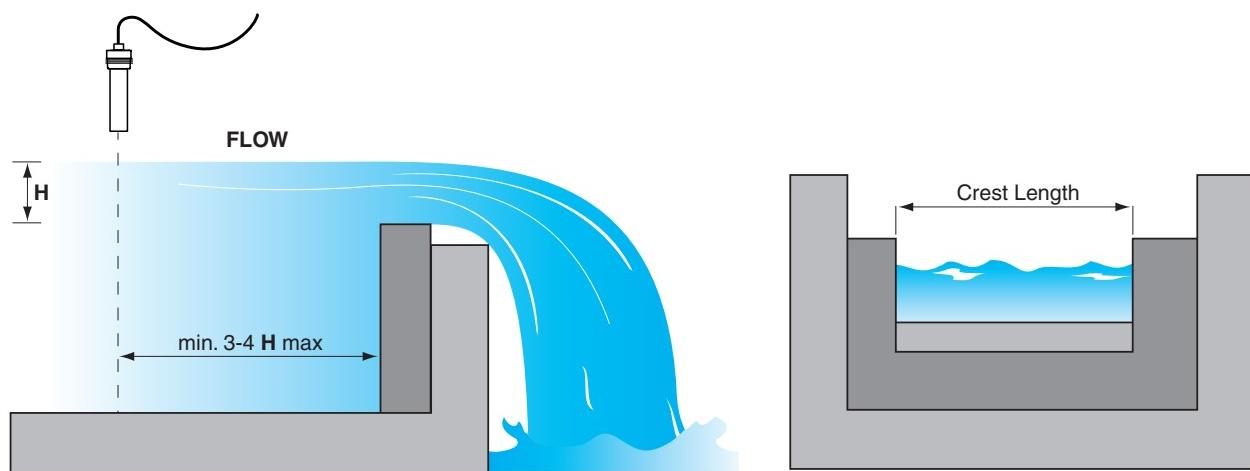
Code	Size
1	22.5°
2	30°
3	45°
4	60°
5	90°
6	120°



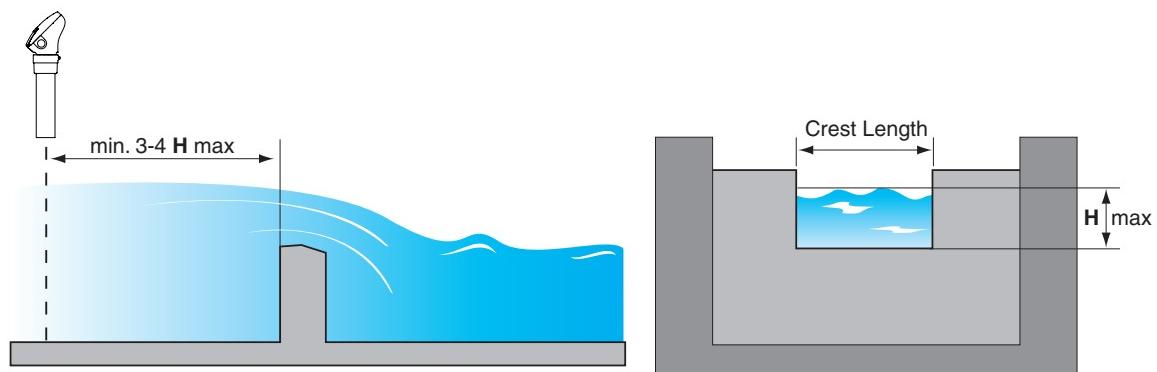
1.7 Types of Flumes and Weirs (Continued)

Rectangular Weirs (Variable Sizes):

Rectangular Weir with End Contractions:



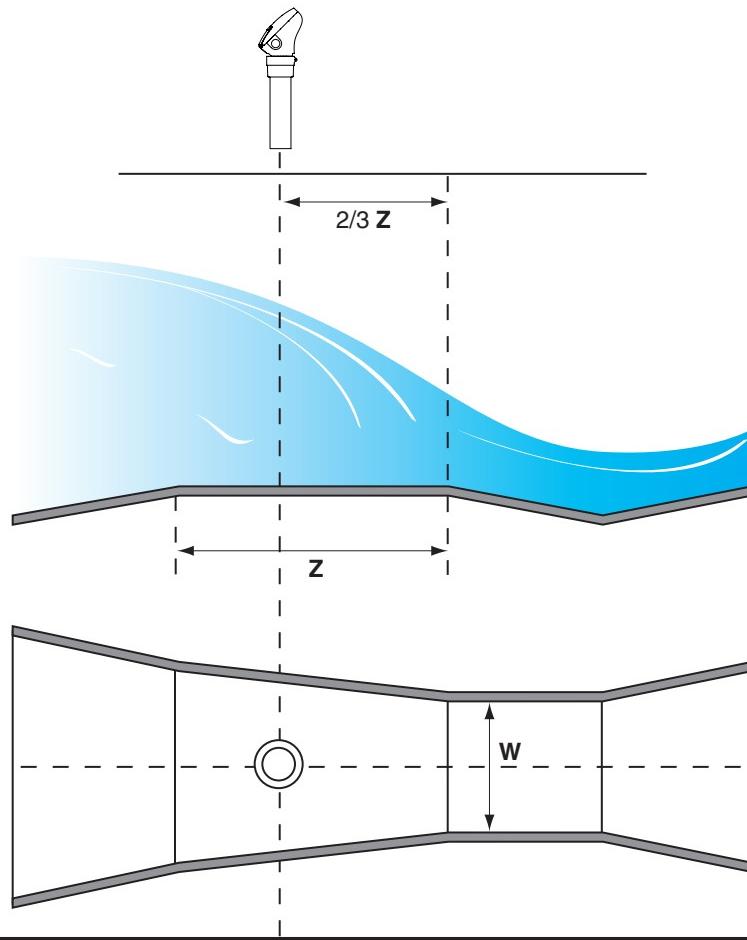
Rectangular Weir without End Contractions:



1.7 Types of Flumes and Weirs (Continued)

Parshall Flumes:

Code	Inches	Millimeters
1	1	25
2	2	51
3	3	76
4	6	152
5	9	229
6	12	305
7	18	457
8	24	610
9	36	914
10	48	1219
11	60	1524
12	72	1829
13	96	2438



Section 2: Installation

2.1 Unpacking

Carefully remove the contents of the shipping carton and check each item against the packing list before destroying any packing material. If there is any shortage or damage, report it to the factory immediately.

2.2 Mounting the Transmitter

The USonic transmitter is available only as an integral construction. The electronic transmitter is located within the tube assembly of the sensor and is not serviceable by the user. Tampering with this construction will void any existing warranties. See Figure 2-1 for standard mounting dimensions.

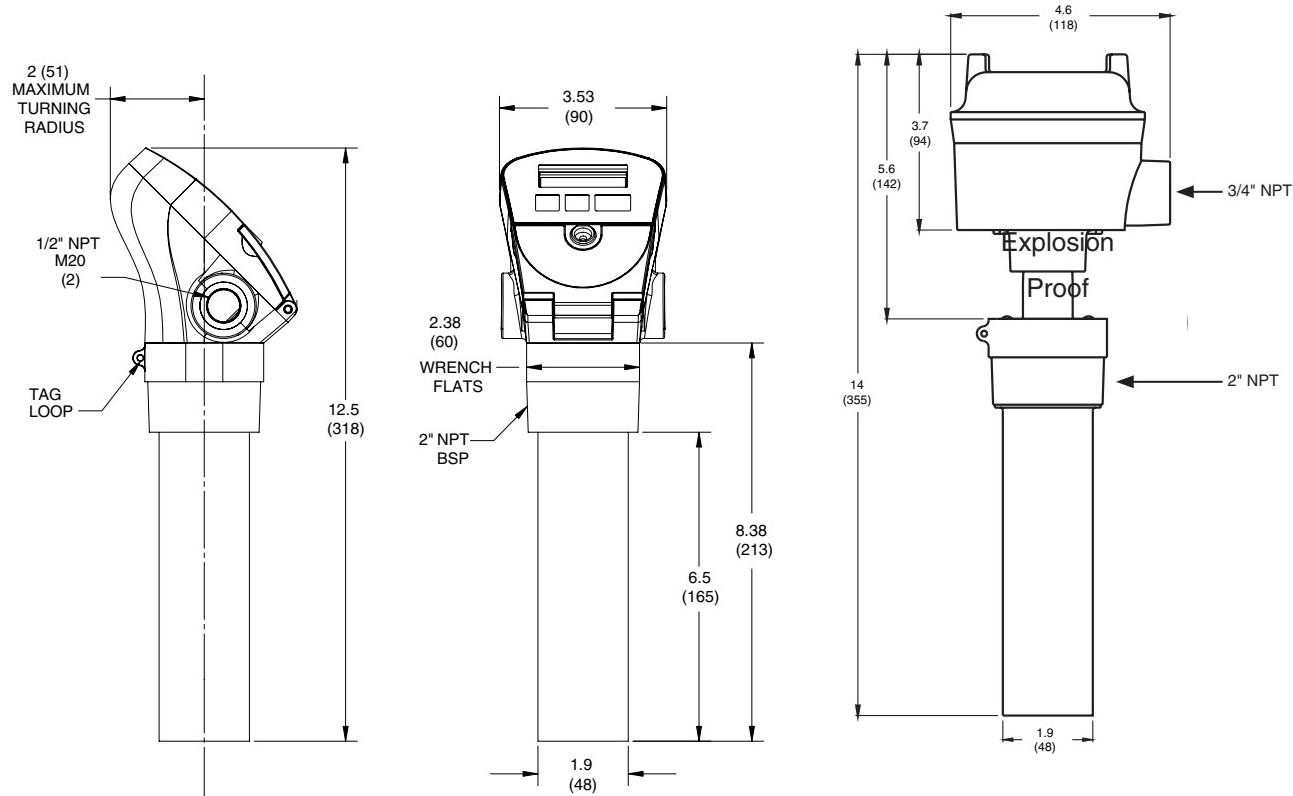


Figure 2-1
Mounting Dimensions



Warning - Potential Electrostatic Charge Hazard

Special Condition for Use:

For Zone 0 installations care should be taken that the plastic sensor be installed and used in such a way that the danger of Electrostatic charge is excluded. For use only on liquid process mediums. Avoid rapid contact between the process medium and the plastic sensor.

2.2 Mounting the Transmitter (Continued)

The USonic Series transmitter is designed for field mounting, but it should be mounted in a location as free as possible from vibration, corrosive atmospheres, and any possibility of mechanical damage.

For convenience when adjusting and configuring, place the USonic Series in a reasonably accessible location. Ambient temperature should be between -40°F to 158°F (-40°C to 70°C).

The transmitter must be mounted vertically with transducer perpendicular to the liquid surface. When mounting the USonic Series transmitter, consideration must be given to the 12-Inch (305 mm) Near Zone. If the level rises to within 12 inches (305 mm) of the sensor face, a user selectable 3.7 mA or 22 mA error signal is generated; Error message (*nErr*) is indicated.

The conical beam of the USonic Series is approximately 10 degrees. Therefore it is necessary to ensure that there are no unnecessary obstructions within this beam path. Erroneous reflections can adversely affect system operation.

For Open Channel Flow use, an optional mounting kit is available for mounting above a flume or weir to position the system above the flow stream. The mounting kit allows movement vertically and horizontally for maximum placement.

- Part # 285-0001-188 (316 SS)

Refer to drawing 285-0001-188-CD for Mounting Details.

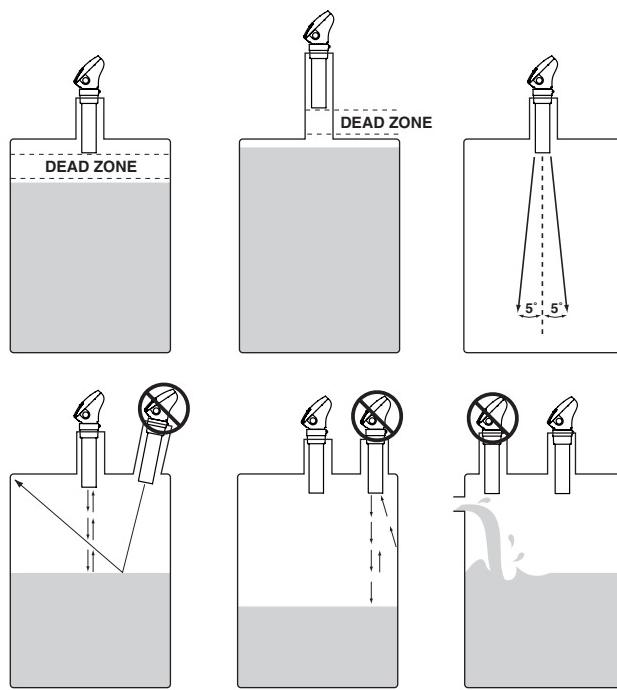


Figure 2-2 Mounting Recommendations

2.3 Wiring the Transmitter



WARNING! If the USonic Series transmitter is located in a hazardous environment, do not open the enclosure cover or make/break any electrical connections without first disconnecting electrical power at the source. Ensure that wiring, electrical fittings and conduit connections conform to electrical codes and Approval Agency Control Drawings for specific location and environment.



See **Figure 2-3** for the wiring diagram of the USonic Series transmitter.

Connect 2-wire input power / signal leads to the terminal block as shown. It is recommended to use twisted, shielded pair to eliminate noise. The shield (or drain) wire should be grounded at the power source and left floating at the USonic Series Transmitter end.

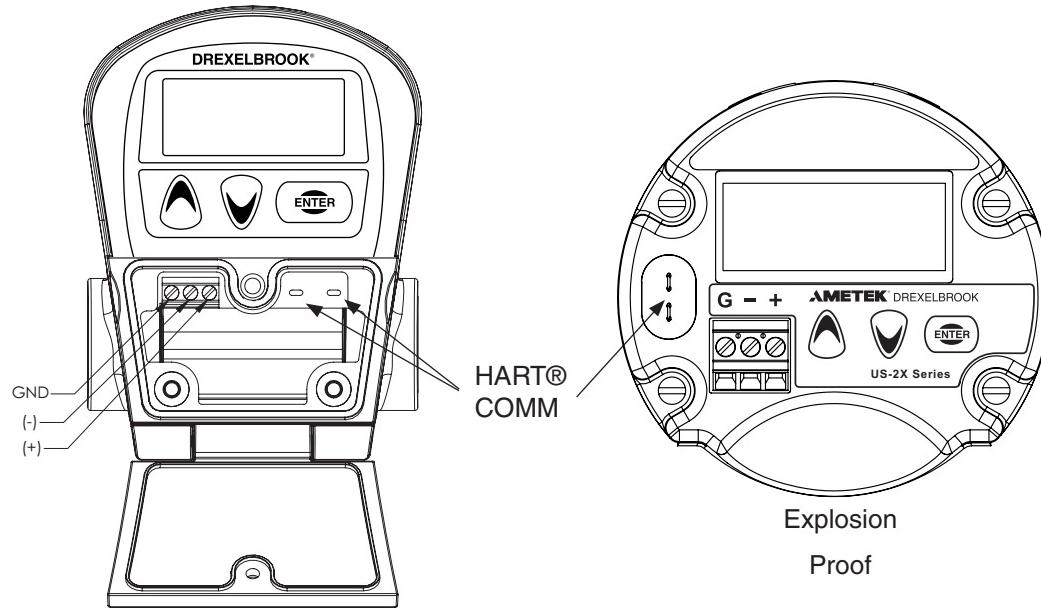
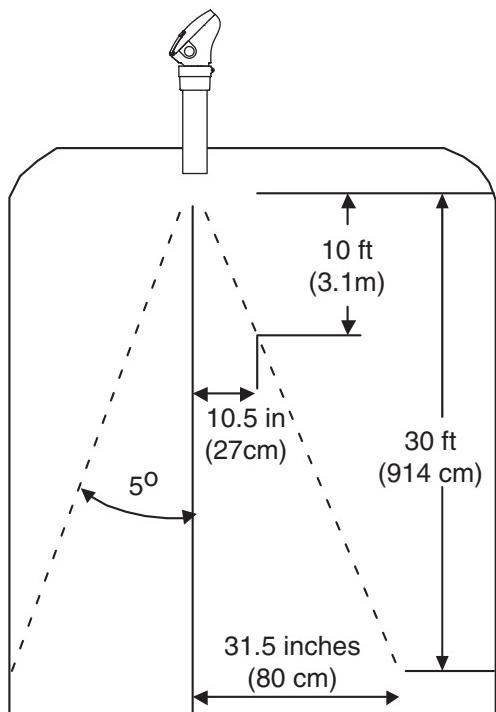
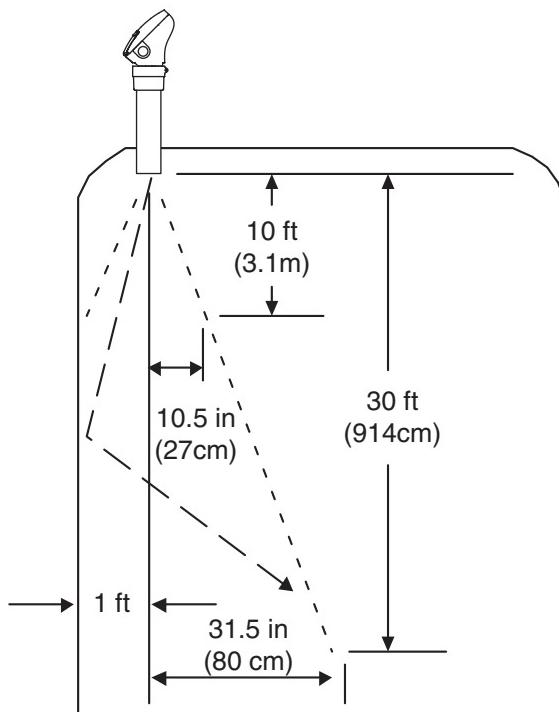


Figure 2-3
Wiring (14 - 22 AWG)

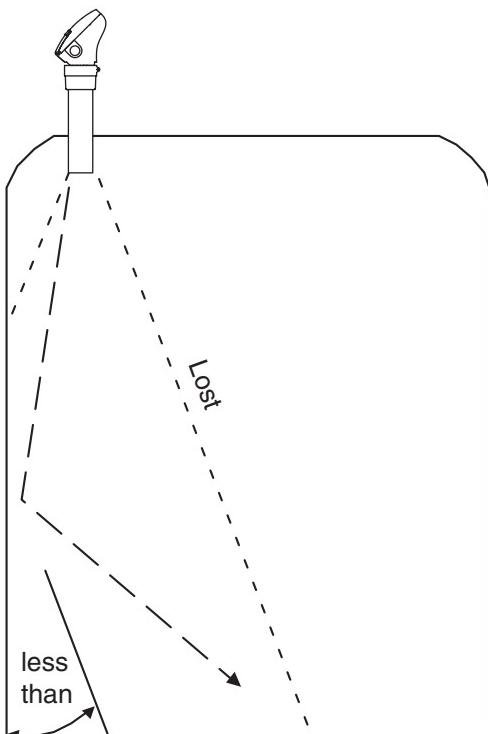
2.4 Installation Examples



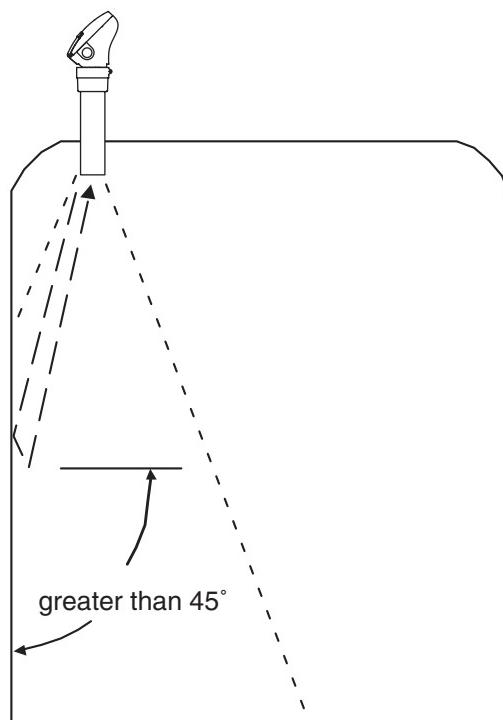
When there are no obstructions within the beam area, there is no chance of false echoes or readings.



Smooth wall in beam with no other obstructions will not cause false echoes.



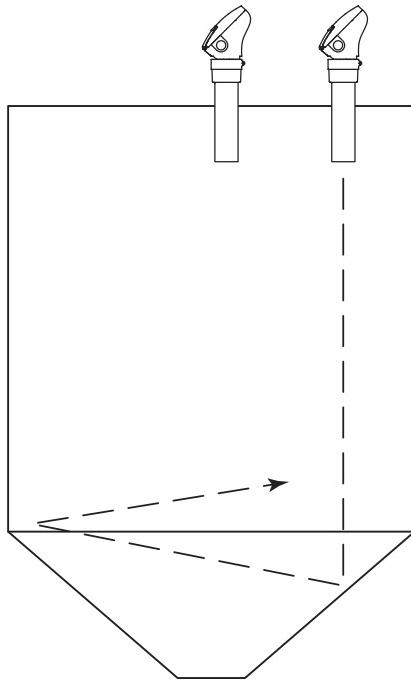
Protrusions from the wall at an angle less than 45 degrees does not cause false echoes.



Protrusion from the wall at an angle greater than 45 degrees may cause false echoes.

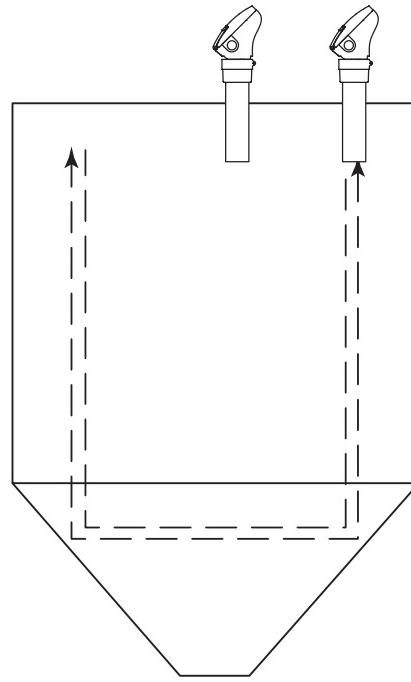
2.4 Installation Examples (Continued)

Preferred Location



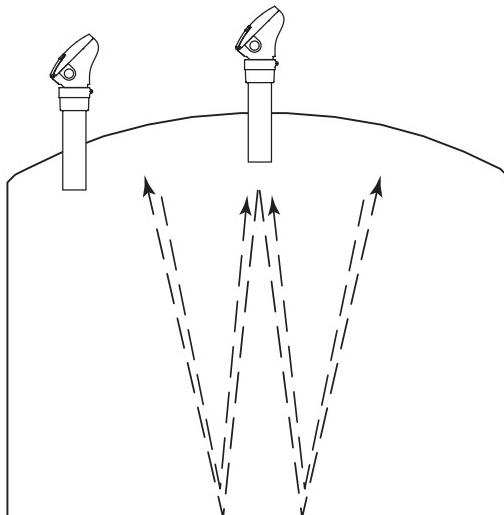
When mounted off center in conical bottom tanks, reflected echoes can reflect away from the transducer in the conical bottom resulting in a lost echo. Move the transducer to the center of the bin for best results.

Preferred Location



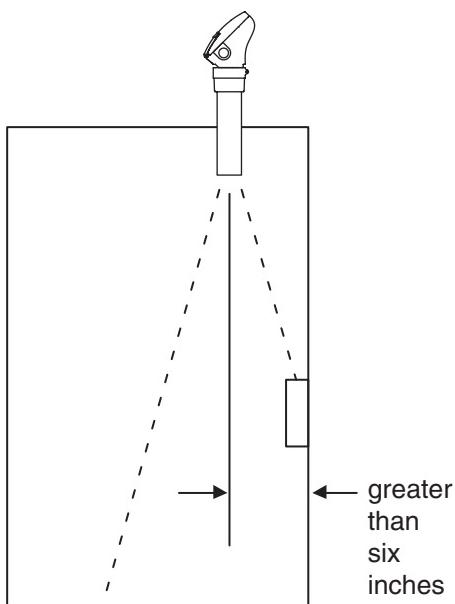
When mounted off center in conical bottom tanks, reflected echoes can be redirected back to the transducer. Use 300ms, 700ms, 1100ms, or 1500ms pulse repeat rate to allow these echoes to subside before transmitting the next pulse and/or move the transducer to another location.

Preferred Location



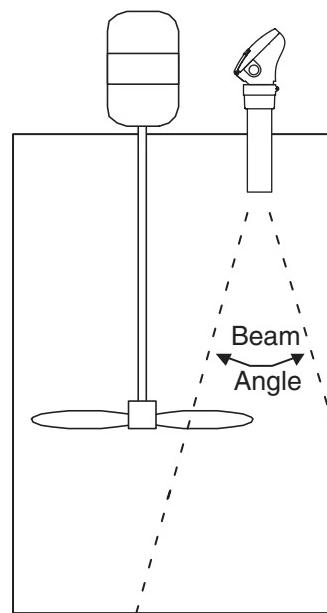
When mounted in the center of domed-roof tanks, reflected echoes can be redirected back to the transducer. Use 300ms, 700ms, 1100ms, or 1500ms pulse repeat rate to allow these echoes to subside before transmitting the next pulse and/or move the transducer to another location.

2.4 Installation Examples (Continued)

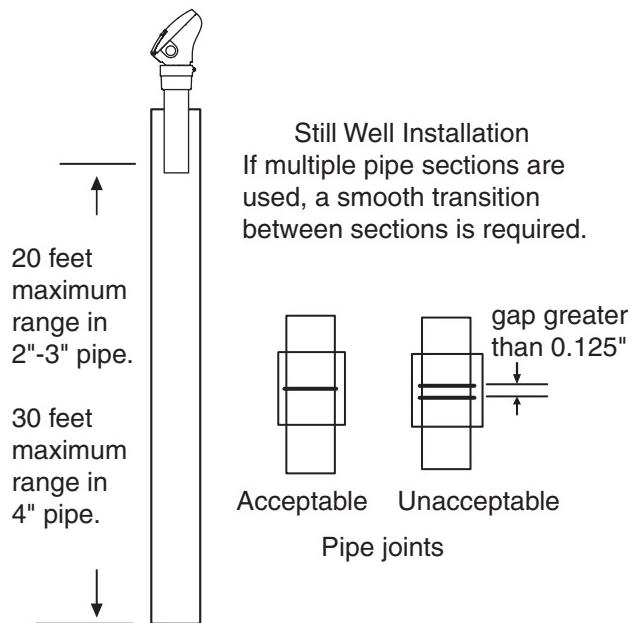


Mounted close to a wall or obstructions are present.
Ability to ignore obstructions will depend on the exact size and location of the obstructions.

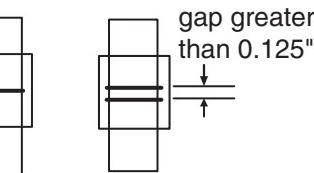
Use standard electronics with high discrimination setting.



Agitators within the beam path



Still Well Installation
If multiple pipe sections are used, a smooth transition between sections is required.



Recommended mounting when recessed in a nozzle.

Section 3: Configuration

3.1 System Configuration with Display / Keypad

The USonic system configuration is made up of 9 separate Functions (Fct.) for system and application set-up per the following:

Input Type:

Function 1.0 allows the user to select an appropriate "Input Type" for the application. The valid Input Types are:

- *LEVEL* (Fct 2.00)
- *INSTANCE* (Fct 3.00)
- *VOLUME* (Fct 4.00)
- *FLOW* (Fct 5.00)

Only one "Input Type" may be selected for the application. Once selected, only the Functions of the selected Input Type will be available.

Strapping Table:

Function 6.00 allows the user to edit the 21-Point user defined table that can provide output signal as a percent of volume or flow.

System Settings:

Function 7.00 allows setting changes to the system configuration.

Display Settings:

Function 8.00 allows the system to display readings in different formats. Any or all may be selected and the display will "cycle" through any or all selected, every 10 seconds.

Calibration:

Function 9.00 allows a 1-Point calibration based on a known distance from the transducer face. This can adjust for any possible variations that may exist in the speed of sound, or to provide an optimized calibration data point in difficult applications, such as vapor.

3.2 Configuration Menu

To enter the Configuration Menu:

- Press and Hold the "Enter" Button for approximately 5 seconds.
- Use the "Up" and "Down" Buttons to scroll through the available menu selections.
- Press "Enter" to access sub-menu items.
- Use the "Up" and "Down" Buttons to adjust settings.
Settings that can be adjusted will be "flashing".
- Press "Enter" to accept the adjustment...Or...
- Press and Hold the "Enter" Button for approximately 5 seconds to exit to the previous menu level.



3.3 Menu Functions (See Section 3.5 for display abbreviations)

Function	Item	Description & comment	Menu Selection Choices
Fct. 1.00	Input Type (TYPE)	Allows the user to navigate the menu based on the appropriate menu item selected (Level, Distance, Volume, Flow). Measurement items not selected cannot be accessed in the menu to reduce needed keystrokes and reduce information errors.	
Fct. 1.01	Level Type (TYPE)	Edit the menu to select Level, Distance, Volume, or Flow. Press ENTER and the default setting will flash, use arrow buttons to cycle through available selections, press Enter again to make selection. Press and Hold Enter key to back out to previous menu item.	LEVEL DISTANCE VOLUME FLOW
Fct. 2.00	Level Menu (LEVEL)	Allows system configuration for level. Only enabled when Level is selected in Fct. 1.01	
Fct. 2.01	Level Units (UNITS)	User selects the units of measurement by "editing" the menu to select either Feet, Inches, Meters, Centimeters, or Millimeters	FEET INCHES METERS CENTIMETERS MILLIMETERS
Fct. 2.02	Tank Height (T_HGT)	Required for accurate Level measurement (Level = Distance - Tank Height). Edit the menu to reflect the correct distance from tank bottom to sensor face	Enter tank height as measured from tank bottom to sensor face
Fct. 2.03	Sensor Offset (OFFSET)	Typically not used in Level Mode, but can be used if sensor is located above (positive offset) or below (negative offset) the value that was entered for Tank Height. Edit the menu from the default display (Inches 000000.00) to correct offset value. Use up arrow button to increase numbers in a positive offset, use down arrow button to increase numbers in a negative offset.	Enter the distance from the maximum tank level (reference point, if different from Tank Height) to sensor face.
Fct. 2.04	LRV	The point in the vessel that the output signal equals 4 mA (0%). Edit the menu to enter the distance from the tank bottom (reference point) to the 4 mA (0%) point	Enter the level unit point where 4 mA will occur, referenced from tank bottom.
Fct. 2.05	URV	The point in the vessel that the output signal equals 20 mA (100%). Edit the menu to enter the distance from the tank bottom (reference point) to the 20 mA (100%) point. This value must not be within the 12 inch Near Zone of the sensor face or an Error Message (NZSEUP) will be displayed.	Enter the level unit point where 20 mA will occur, referenced from tank bottom.
Fct. 3.00	Distance (DISTNCE)	Allows the system configuration for distance. Only enabled when Distance is selected in Fct. 1.01	

3.3 Menu Functions (Continued)

Function	Item	Description & comment	Menu Selection Choices
Fct. 3.01	Distance Units (UNITS)	User selects the units of measurement by "editing" the menu to select either Feet, Inches, Meters, Centimeters, or Millimeters	FEET INCHES METERS CENTIMETERS MILLIMETERS
Fct. 3.02	LRV	The point in the vessel that the output signal equals 4 mA (0%). Edit the menu to enter the distance from the sensor face (reference point) to the 4 mA (0%) point. This value must not be within the 12 inch Near Zone of the sensor face or an Error Message (NZSEUP) will be displayed.	Enter the level unit point where 4 mA will occur, referenced from sensor face.
Fct. 3.03	URV	The point in the vessel that the output signal equals 20 mA (100%). Edit the menu to enter the distance from the sensor face reference point) to the 20 mA (100%) point.	Enter the level unit point where 20 mA will occur, referenced from sensor face.
Fct. 4.00	Volume (VOLUME)	Allows the system configuration for volume. Only enabled when Volume is selected in Fct. 1.01	
Fct. 4.01	Level Units (L UNITS)	User selects the level units of measurement for input conversion by "editing" the menu to select either Feet, Inches, Meters, Centimeters, or Millimeters.	FEET INCHES METERS CENTIMETERS MILLIMETERS
Fct. 4.02	Tank Height (T_HGT)	Required for accurate maximum Level to maximum Volume Conversion. Edit the menu to reflect the correct distance from tank bottom to sensor face.	Enter tank height as measured from tank bottom to sensor face or maximum capacity reference point.
Fct. 4.03	Sensor Offset (OFFSET)	Used if sensor is located above (positive offset) or below (negative offset) the value that was entered for Tank Height. Edit the menu from the default display (Inches 000000.00) to correct offset value. Use up arrow button to increase numbers in a positive offset, use down arrow button to increase numbers in a negative offset.	Enter the distance from the maximum tank volume reference point, (if different from Tank Height) to sensor face.
Fct. 4.04	Vessel Type (VES_TYP)	Edit the menu to select the vessel shape that is being used. A strapping table will be generated based on Vessel shape (Vertical Cylinder, Horizontal Cylinder with Flat Ends, Horizontal cylinder with Dished Ends, Horizontal cylinder with Hemispherical Ends, or a Sphere. A Custom (User Defined) selection can also be made that will require the use of the 21-point strapping table to correlate level to known volumes. Information entered in Tank Height, Maximum Capacity and Sensor Offset is used to generate the correct table.	VERT HC_F HC_D HC_H SPHERE CUSTOM
Fct. 4.05	Load Standard Table into Strapping Table (LOADSTD)	Allows the user to enter a standard strapping table for volume conversion. Edit the menu to select the tank shape that best fits the application. This information can be later modified in Fct. 6.00 Strapping Table to generate a more accurate level to volume conversion table for custom or irregular tank shapes.	VERT HC_F HC_D HC_H SPHERE
Fct. 4.06	Vessel Units (V UNITS)	Allows the user to enter the volume units that will be used for display purposes. Edit the menu to make this selection. Press ENTER and the default setting will flash, use arrow buttons to cycle through available selections, press Enter again to make selection.	GALLONS M3 (cubic meters) LITERS BBL (barrels) IMPGAL (imperial gallons)

3.3 Menu Functions (Continued)

Function	Item	Description & comment	Menu Selection Choices
Fct. 4.07	Maximum Capacity (MAX CAP)	Allows user to enter the volume of the vessel's maximum capacity that correlates to the Tank Height level.	Enter maximum capacity in vessel units selected.
Fct. 4.08	LRV	The point in the vessel that the volume equals 4 mA (0%). Edit the menu to enter the distance from the tank bottom to the 4 mA (0%) point.	Enter the volume unit point where 4 mA will occur, referenced from tank bottom.
Fct. 4.09	URV	The point in the vessel that the volume equals 20 mA (100%). Edit the menu to enter the distance from the tank bottom to the 20 mA (100%) point. This value must not be within the 12-inch Near Zone of the sensor face or an Error Message (NZSEUP) will be displayed.	Enter the volume unit point where 20 mA will occur, referenced from tank bottom.
Fct. 5.00	Flow (FLOW)	Allows the system configuration for open channel flow measurements. Only enabled when Flow is selected in Fct. 1.01	
Fct. 5.01	Flume Type (FLO_TYP)	Allows user selection of software supported flume / weir types. Select from Parshall, Palmer-Bowlus, Trapezoidal Flume, Rectangular Weir With end contractions, Rectangular Weir With Out end contractions, Cipolletti (Trapezoidal) Weir, V-Notch Weir, "H" Flume, Leopold-Lagco, or CUSTOM (user defined, enter level to flow relationship in the 21-point strapping table).	PARSH PB TRAP F RECT W RECT WO TRAP W V NOCH CUSTOM H FLUME LEO LAG
Fct. 5.02	Flume Size (F SIZE)	Allows user selection of flume "throat size" of flume type selected in Fct. 5.01, select the size code from the available listings in Section 1.7	Consult Manual for specific code based on flume/weir type and size.
Fct. 5.03	Flow Units (F UNITS)	Select if displayed units will be in GPM, MGD or M3/Hr. LPS (Liters Per Second), LPM	GPM / MGD / M3/HR / LPS / LPM
Fct. 5.04	Max Flow (MAX FLO)	Edit this menu to reflect the maximum flow rate expressed in the flow units selected in Fct. 5.03	Enter the maximum flow value in selected Flow Units
Fct. 5.05	Head Units (H UNITS)	Allows user to edit the menu to select head (level) measurement units. This information is used for display indication and also if custom flume or weir information is generated in the 21-point strapping table.	FEET INCHES METERS CENTIMETERS MILLIMETERS
Fct. 5.06	Distance to Zero Flow (0 DST)	Allows the user to edit the menu to provide the distance from the sensor face to the "zero flow" point in the primary element (flume or weir). Check primary flow element drawings, not all primary elements have a zero flow reference point at the bottom.	Enter the distance from sensor face to the zero flow level
Fct. 5.07	Sensor Offset (OFFSET)	If the flume/weir is selected from the preprogrammed menu selections, no user input is required, offset equals zero. If using custom characterization in strapping tables, enter the distance from maximum flow (20 mA) point to the sensor face.	Enter distance from Max Flow (Fct. 5.04) to sensor face. Not used if flume type and size are from menu selection.
Fct. 5.08	Totalizer Scale (T SCALE)	Allows the user to edit the menu selection to select the totalizer scale. Every count on the totalizer will be multiplied by the selection made.	X1 X10 X100 X1K X10K X100K X1Mil
Fct. 5.09	Totalizer Reset? (RESET?)	There are two totalizers contained in the USonic. The user can reset one of the totalizer. This menu item allows the user to reset the resettable totalizer by editing the menu to "Yes". At this point the Reset Totalizer will reset to zero and start counting once returned to the operate mode.	NO / YES

3.3 Menu Functions (Continued)

Function	Item	Description & comment	Menu Selection Choices
Fct. 6.00	Strapping Table (STRAP)	Allows the system configuration for the strapping table. Enabled when Flow or Volume is selected in Fct. 1.01. The strapping table is a look-up table of level vs. volume (or flow rate) that is entered by the user based on known parameters.	
Fct. 6.01	Maximum Points (MAX PNT)	The strapping table is capable of 21 points, from 0% to 100% in 5% increments. Depending on how many "break points" that may be needed for vessel, flume or weir, enter the number of break points for this selection by editing this menu item.	2...21
Fct. 6.02	In Point 1 (INPT 1)	Edit this menu item to enter the "level" information for the first point	Enter input 1, the units of measure will be dependant on Input Type and Units selected
Fct. 6.03	Out Point 1 (OUTPT 1)	Edit this menu item to enter the "volume/flow rate" information for the first point	Enter output 1, the units of measure will be dependant on Volume Type and Units selected
6.04 - 6.43	In/Out Points 2-21	Enter Level "IN" points and Volume / Flow rate "Out" Points for each of the break points entered in Fct. 6.01	Enter Input / Output for the number of break points entered for Maximum Points in Fct. 6.01
Fct. 7.00	System Settings (SYSTEM)	Allows the system configuration for various parameters of the system setting.	
Fct. 7.01	Temperature Units (TMP UNT)	Allows the user to select if temperature will be displayed in degrees Fahrenheit or Celsius	°F °C
Fct. 7.02	Gain Adjustment (GAIN)	Should only be changed with guidance from a Drexelbrook representative. This item allows the user to change from the default HD setting (SmartGain™) to a fixed power level. Useful if foam is present that causes a Lost of Echo fault. Consult Factory before use. HD_HIGH - Use in foamy or vaporous conditions	HD HD HIGH 100% 84% 67% 50% 32% 17% 8% Consult Factory before use.
Fct. 7.03	HD Adjustment (HD GAIN)	Should only be changed with guidance from a Drexelbrook representative. This item allows the user to change from the default HD setting (SmartGain™) to a lower variable power level, but still allowing the system to ignore some obstructions within the beam path. Consult Factory before use.	User numerical entry between 0 - 100 Consult Factory before use.
Fct. 7.04	Repetition Rate (PR RATE)	In some cases it may be desirable to change the transmission repetition rate. Normal default is 300 ms. Longer Repetition rates may be useful in some instances of intermittent presence of foam, or agitator blades in the beam path. Consult Factory before use.	300 MS / 700 MS / 1100ms / 1500ms Consult Factory before use.
Fct. 7.05	Acquisition (ECHOES)	Defines the number of echoes that must be received to determine a valid level acquisition. Default setting is 4 return echoes. If the level surface is rough and uneven, this setting may be set to a lower number to validate a level acquisition. If there are disturbances in the vessel that cause intermittent false target acquisitions, this number may be increased. Consult Factory before use.	1 – 4 – 10 maximum Consult Factory before use.
Fct. 7.06	Time Delay (DAMPING)	Time delay will act as signal averaging over the specified time 0-90 seconds. If a turbulent surface causes the analog signal to be unsteady, a few seconds of time delay can smooth out the signal.	User numerical entry 0 – 90
Fct. 7.07	Near Zone Fault (NZ OUT)	If the level moves into the Near Zone (12 inches from sensor face) the user can, in this menu item select the current level the analog signal will assume (3.7 mA or 22 mA) during a fault condition.	HIGH (22 mA) LOW (3.7 mA)

3.3 Menu Functions (Continued)

Function	Item	Description & comment	Menu Selection Choices
Fct. 7.08	Lost Echo Fault (LE OUT)	If the echo is not returned to the sensor, the user can, in this menu item select the current level the analog signal will assume (3.7 mA or 22 mA) during a fault condition. Last Known Value (LST_VAL) - Will hold the output current and reading to the last received value before the lost echo condition. USE WITH EXTREME CAUTION!	HIGH (22 mA) LOW (3.7 mA) LST VAL
Fct. 7.09	Force Current (LOCK mA)	This menu item allows the user to edit a mA current level that the system will constantly generate only while in this menu item. To return to a normal operating mode (normal mA outputs), exit the menu or Enter 0.00 mA to return to normal.	User defined numeric value
Fct. 7.10	Trim 4 mA (TRIM 4)	This menu item allows the user to edit the 4.0 mA output current to match a known meter. The valid range is from 3.5 to 4.5 mA. This allows the system to change its 4.0 mA reference current level to match a standard.	User defined numeric value between 3.5 – 4.5 mA
Fct. 7.11	Trim 20 mA (TRIM 20)	This menu item allows the user to edit the 20.0 mA output current to match a known meter. The valid range is from 19 to 21 mA. This allows the system to change its 20.0 mA reference current level to match a standard.	User defined numeric value between 19 – 21 mA
Fct. 7.12	HART Mode (HART MD)	If operating in the digital HART mode this menu item allows the user to match the input requirements of a DCS/PLC by either assigning a X1 multiplier or an X100 multiplier that is need by some DCS/PLC's. Check with your DCS/PLC to see if this is necessary.	NORMAL - (output % X 1) DCS - (output % X 100)
Fct. 7.13	Polling Address (POLL)	If operating in the digital HART mode this menu item allows the user to assign a polling address to the transmitter valid entries are 1-15. A "0" polling address indicates analog output operation - and is the default.	Select polling address between 1 – 15 (address "0" used for all analog outputs)
Fct. 7.14	Restore Factory Defaults? (RST FAC)	Selecting Yes will reset all configured parameters to the Factory Default positions, just like it came out of the box. This is useful if too many technicians have made configuration changes to the point where no one knows how or if this system is correctly configured. Start from the beginning again.	YES / NO
Fct. 7.15	Change Password (CHG PAS)	Allows a user generated a 7-character password to allow access to the configuration menu. To edit this item you will see a blinking cursor followed by 6 o's (_oooooo). To edit use the up & down arrow buttons to select Up, Down or Enter - press the Enter button to select and the blinking cursor will move to the next position (o _oooooo). Repeat until all 7 positions have been entered. Record this password. Upon re-entering the configuration menu, this password will be required.	Select UP, DOWN, ENTER for each digit of a seven digit password.
Fct. 7.16	Password Enabled? (PASS EN)	Edit this menu item to activate the password. Selecting Yes will make the password Required the next time the Menu is entered.	YES / NO
Fct. 7.17	Contrast (CONTRAST)	This item allows the user to change the display contrast depending on ambient lighting conditions. Default is 10, available range is 0-50.	0 - 50
Fct. 7.18	Low Offset (LO OFST)	Ping energy level setting for Low Gain Amplifier. Consult Factory Before Use	User numerical entry (-1, 0 +1) Consult Factory Before Use
Fct. 7.19	High Offset (HI OFSET)	Ping energy level setting for High Gain Amplifier. Consult Factory Before Use	User numerical entry (-1, 0 +1) Consult Factory Before Use

3.3 Menu Functions (Continued)

Function	Item	Description & comment	Menu Selection Choices
Fct. 7.20	Pipe Length (PIPE_L)	This item allows the user to enter the length of the pipe in which the USonic is installed.	0 (Edit length in level Units), - for open air (no pipe) use 0
Fct. 7.21	Pipe Diameter (PIPE_D)	This item allows the user to enter the diameter of the pipe in which the USonic is installed.	2", 3", 4", 6", 8", 10", 12" (Pipe diameters greater than 12" are treated as open-air installations)
Fct. 8.00	Display Toggle (DISPLAY)	Allows the system configuration for the desired display options. Use this menu to select which displays will be available to view during operation.	
Fct. 8.01	Toggle? (TOGGLE)	This menu item allows the user to select if the display will automatically cycle through the display choices or manually cycle through the display options selected. Manually cycle the display options selected by pressing any arrow key during operation.	YES / NO If YES, unit will scroll every 10 seconds If NO, unit can be manually advanced through all enabled selections using up/down arrow keys
Fct. 8.02	Display Level? (LEVEL)	This item allows you to select (or deselect) Level as a desired display.	ENABLE / DISABLE
Fct. 8.03	Display Distance? (DISTNCE)	This item allows you to select (or deselect) Distance as a desired display.	ENABLE / DISABLE
Fct. 8.04	Display Volume? (VOLUME)	This item allows you to select (or deselect) Volume as a desired display.	ENABLE / DISABLE
Fct. 8.05	Display Flow? (FLOW)	This item allows you to select (or deselect) Flow rate as a desired display.	ENABLE / DISABLE
Fct. 8.06	Display Totalizer? (TOTAL)	This item allows you to select (or deselect) the non-resettable Totalizer as a desired display.	ENABLE / DISABLE
Fct. 8.07	Display Reset Totalizer? (R TOTAL)	This item allows you to select (or deselect) the user resettable Totalizer as a desired display.	ENABLE / DISABLE
Fct. 8.08	Display Current Output? (OUTPUT)	This item allows you to select (or deselect) milliamp output current as a desired display.	ENABLE / DISABLE
Fct. 8.09	Display Temperature? (TEMP)	This item allows you to select (or deselect) the internal sensor temperature compensator as a desired display.	ENABLE / DISABLE
* Note Range Percent is always present for display and can not be enabled or disabled.			
Fct. 9.00	Calibration (CAL)	This menu item allows the user to calibrate the system if ultrasonic velocities other than through air are present.	
Fct. 9.01	Point (PT CAL)	A point calibration allows the system to reset the expected ultrasonic velocity to a new value. Consult factory before use. If vapors are present or a gas blanket is used, the ultrasonic velocity will be different than would be expected in a through-air application. This menu item is used to alter this calculated velocity. Edit this menu item with the actual distance to the known level and the system will back calculate the velocity that produces this level measurement.	User defined numeric value of actual distance from liquid level to sensor face. Allows adjustment up to +/- 25%

3.4 Error Messages

-LOST-	Lost Echo
-NEAR-	Near Zone
NO COM / BRI COM	Communications Error Between Display and Transmitter
EEPROM	EEPROM Error
-SETUP-	Setup Error Parameter Setup beyond Range of Transmitter
TEMP	Temperature Sensor Error
NZSEUP	Parameter Setup in Near Zone
-UNDER-	Under Range
-OVER-	Over Range
-SPAN-	Span too Small

3.5 Menu / Display Abbreviations

Display	Definition
DIST	Distance to Zero Flow
CAL	Optimized Calibration
CM	Centimeters
CUSTOM	User Defined
DAMPING	Input time delay
DCS	HART DCS
DISPLAY	Display
DIST	Distance
FLO_TYP	Flume Type
FLOW	Flow
FT	Feet
GAIN	Gain Adjust
GPM	Gallons per Minute
HC_D	Horizontal Cylinder – Dished ends
HC_F	Horizontal Cylinder – Flat ends
HC_HEMI	Horizontal Cylinder – Hemispherical ends
H_FLUME	H Flume
IN	Inches
LEOLAG	Leopold Lagco
LEV	Level
LEVEL	Level
LOGFCT	Logic Function
LOST	Lost Echo
LPM	Litres per Minute
LPS	Litres per Second
LRV	LRV
M3	Cubic Meters per hour
MAX_CAP	Maximum Capacity
M	Meters
MGD	Million Gallons Per Day
MM	Millimeters
NEAR	Near Zone

Display	Definition
NORMAL	HART Normal
OFFSET	Sensor Offset
PARTH	Parshall
PASWRL	Password
PB	Palmer Bowlus
PTCAL	Point Calibration
RECT_W	Rectangular with end contractions
RECT_WO	Rectangular without end contractions
RESETP	Reset? Yes or No
RNG	Range
RP RATE	Repetition Rate
RTL	Reset Totalizer
SPHERE	Sphere
STRAP	Strapping Table
SUREP	Confirm
TEMP	Temperature Display
T_HGT	Tank Height
TL	Totalizer
TRAP_F	Trapezoidal Flume
TRAP_W	Trapezoidal Weir
TYPE	Input Selection
UNITS	Unit Selection
URV	URV
VERT	Vertical
VNOTCH	V Notch
VOL	Volume
X_1	X1
X_10	X10
X_100	X100
X_1K	X1000
X_10K	X10000
X_100K	X100000
X_1M	X1,000,000

Section 4: Troubleshooting

The USonic™ Series Ultrasonic Level system is designed to give years of unattended service. No periodic or scheduled maintenance is required.

4.1 Troubleshooting Procedures

If a problem should occur with the operation of the transmitter, use the following procedure for troubleshooting.

1. Ensure wiring connections are correct.
 2. If the liquid surface has severe turbulence in the area where the ultrasonic beam hits, consider increasing damping time.
 3. Splashing of material or condensation on the transducer face could cause unreliable measurements.
 4. Any continuous ultrasonic transmitter signal/echo can be adversely affected by significant foam on the liquid level surface. If this condition exists, please consult the factory for further application review and advice.
 5. Ensure that the transducer face is not recessed into a mounting nozzle, unless a high discrimination setting is used. Spurious reflections from the nozzle can cause faulty operation.
See Function 7.20 & 7.21
 6. To indicate a fault condition, the 4-20 mA signal locks to 22 mA (or 3.7 mA). If output is locked at 22 mA (or 3.7 mA), check that:
 - A) The level of the material has not violated the near zone (12 inches, 30 cm) from the transducer face.
 - B) The low calibration setting is not more than 360 inches (30 ft., 610 cm) from the transducer face.
 7. Test for 4 mA and 20 mA.
 - A) Using PC Software, HART Communicator, or Display Keypad (Access Fct.7.09) to force the output signal to a constant 4 mA or 20 mA.
 8. If attempts to locate the difficulty fail, notify the local factory representative, or call Drexelbrook directly.
- To aid in troubleshooting, please complete the information in Section 4.5 before calling the factory service department.

4.2 Optimized Field Calibration

Configuration Menu Function 9.01 allows a 1-Point calibration based on a known actual distance. This can adjust for any possible variations that may exist in the speed of sound, or to provide an optimized calibration data point in difficult applications.

- Using PC Software, HART Communicator, or Display Keypad (Access Fct. 9.01) and enter the correct actual distance from the transducer face to level. The USonic will use this data point as reference on all future readings, unless "Restore Factory Settings" is selected.

4.3 Troubleshooting the Loop Connections.

Specific transmitter loop connections vary with each installation, but in general are connected in a similar manner to the typical transmitter loop in Figure 4-1.

When troubleshooting the loop connection, verify the following items.

- Loop devices are wired in series.
- There is at least 250 ohms total loop resistance.
- There is at least 19 Vdc available for the transmitter when a loop current of 4 mA is flowing.
- Refer to Figure 4-1

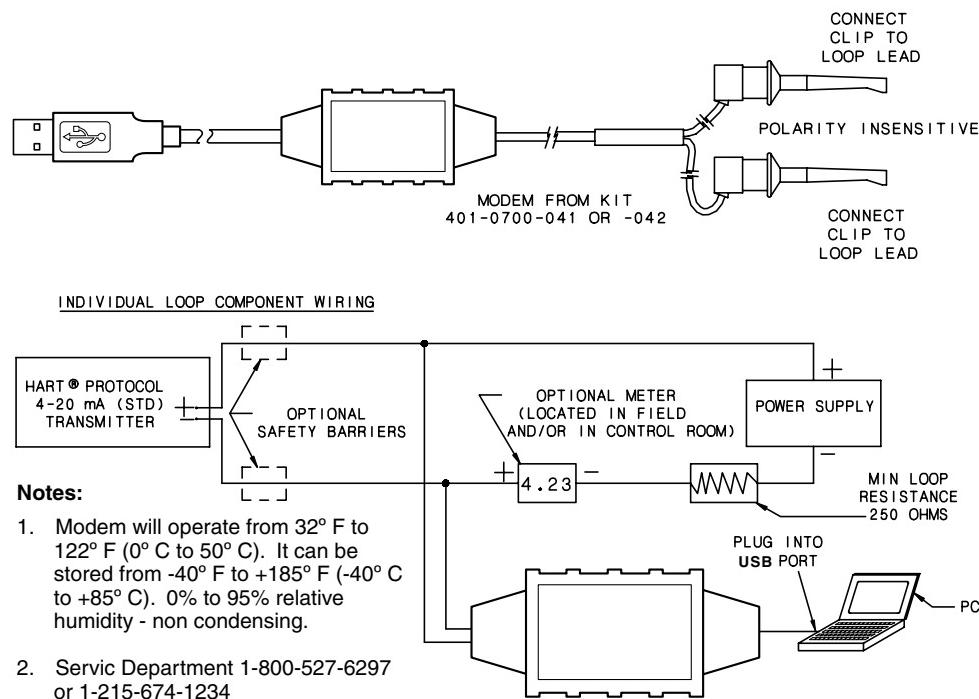
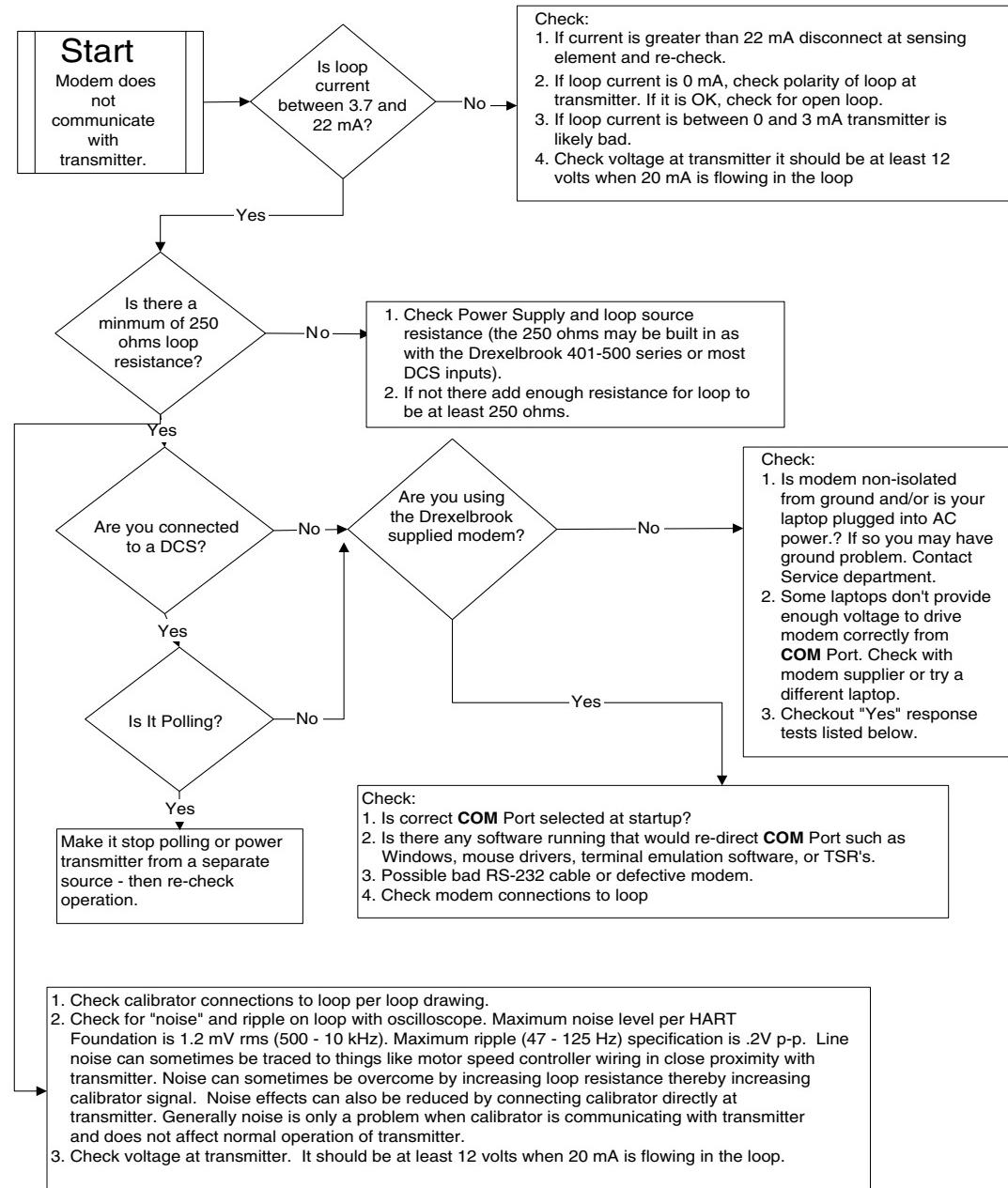


Figure 4-1
Typical Transmitter Loop

4.3 Troubleshooting the Loop Connections (Continued)



4.4 Diagnostic Messages

Message	Cause	Solution
LOST	Lost Echo	<ol style="list-style-type: none"> 1) Ensure the level is within the measurement range of the transducer. 2) Look for any obstructions that may be interfering with the return echo.
NEAR	Near Zone Violation	The level has entered the transducers Near Zone. Insure that there is no level or obstructions within 12 inches of the transducer face.

4.5 Telephone Assistance



If you have questions about your AMETEK Drexelbrook equipment:

- Contact your local Drexelbrook representative
- Call the Drexelbrook Service department toll-free at:
1-800-527-6297 (US and Canada) or
215-674-1234 (Outside North America)
- Fax the following information to the Service department at:
215-443-5117.

To expedite assistance, please provide the following information:

Instrument Model Number: _____

Original Purchase order number: _____

Material being measured: _____

Temperature: _____

Pressure: _____

Agitation: _____

Brief description of the problem: _____

Checkout procedures that have failed: _____

4.6 Equipment Return / Warranty

In order to provide the best service, any equipment being returned for repair or credit must be pre-approved and have a return number issued by the factory.

In many applications, the equipment is exposed to hazardous materials.

- OSHA mandates that our employees be informed and protected from hazardous materials.
- Material Safety Data Sheets (MSDS) listing the hazardous material that the system has been exposed to must accompany any return.
- It is your responsibility to fully disclose all chemicals and decontaminate the returned items.

4.6 Equipment Return (Continued)



To obtain a return authorization number (RA#), contact the Service department at:
1-800-527-6297 (US and Canada) or
215-674-1234 (Outside North America).

Please provide the following information:

Model Number of Returned Equipment: _____

Serial Number: _____

Original Purchase Order Number: _____

Process Material that the equipment has been exposed: _____

MSDS for any hazardous materials

Billing Address: _____

Shipping Address: _____

Purchase Order Number for Repairs: _____

Please include a purchase order number even if the repair is under warranty. If repair is covered under warranty, you will not be charged.

Ship equipment freight prepaid to:

AMETEK Drexelbrook
205 Keith Valley Road
Horsham, PA 19044

COD shipments will not be accepted.

AMETEK Drexelbrook warrants its products free of material defects or manufacturing defects for a period of 1 year after date of shipment.

4.7 Field Service

Trained field service personnel are available on a time-plus-expense basis to assist in start-ups, diagnosing difficult application or equipment problems, or in-plant training of personnel. Preventive Maintenance and Calibration Certification service contracts are also available to maintain plant efficiency. Contact the Service department for further information.

Section 5:

Section 5: Configuration and Calibration With HARTWin™

This section instructs the user how to use the Drexelbrook 401-700-20/40 Series PC calibrator software to configure and calibrate the USonic™ Transmitter.

5.1 General Description

The 401-700-20/40 software package allows the use of any Windows® 9X/NT/2000/XP-based personal, laptop, or notebook computer to calibrate the HART® Protocol transmitter.

The USonic™ transmitter is compatible with HARTWin™ 2.4 or greater.

5.2 Model Number

4 0 1 - 0 7 0 0 - 0 2 X / 4 X

2X= 1 PC Software Package includes:

RS232 Modem Assembly 401-0700-004 (*Figure 5-1*).

2X=2 PC Software Package includes:

Contents in 401-0700-021, HARTWin™ version 2.1 or greater on a CD-ROM.

4X=1 PC Software Package includes:

USB Modem Assembly 401-0700-007 (*Figure 5-1a*).

4X=2 PC Software Package includes:

Contents in 401-0700-41, Utilities and Drivers on a CD-ROM, and HARTWin™ version 2.3 or greater on a CD-ROM.

4 0 1 - 0 7 0 0 - 0 3 1

HARTWin™ version 2.X on a CD-ROM.

5.3 System Requirements

PC Requirements

Windows® 95, 98, ME, 2000, XP.

The USB modem is not compatible with Windows® 95, 98 First Edition, or NT. It is recommended that the software be installed on a hard drive with 20 megabytes or more of space available.

Input to Modem

RS232 or USB Port, from one of the COM serial ports (COM1, COM2, etc..). The PC provides operating power for the modem but not for the transmitter.

Output (to Transmitter being Calibrated)

4-20 mA in HART® Protocol.

5.4 Installing The RS232 Modem

Refer to Figure 5-1 for a connection diagram and use the following procedure to install the hardware that is necessary to run the PC software.

1. Connect the RS232 Drexelbrook Modem 401-700-004 to one of the **COM** serial ports (**COM1**, **COM2**, etc.) of the computer.
2. Connect the Modem's 4-20 loop connectors to the transmitter loop.
3. Turn on the computer.

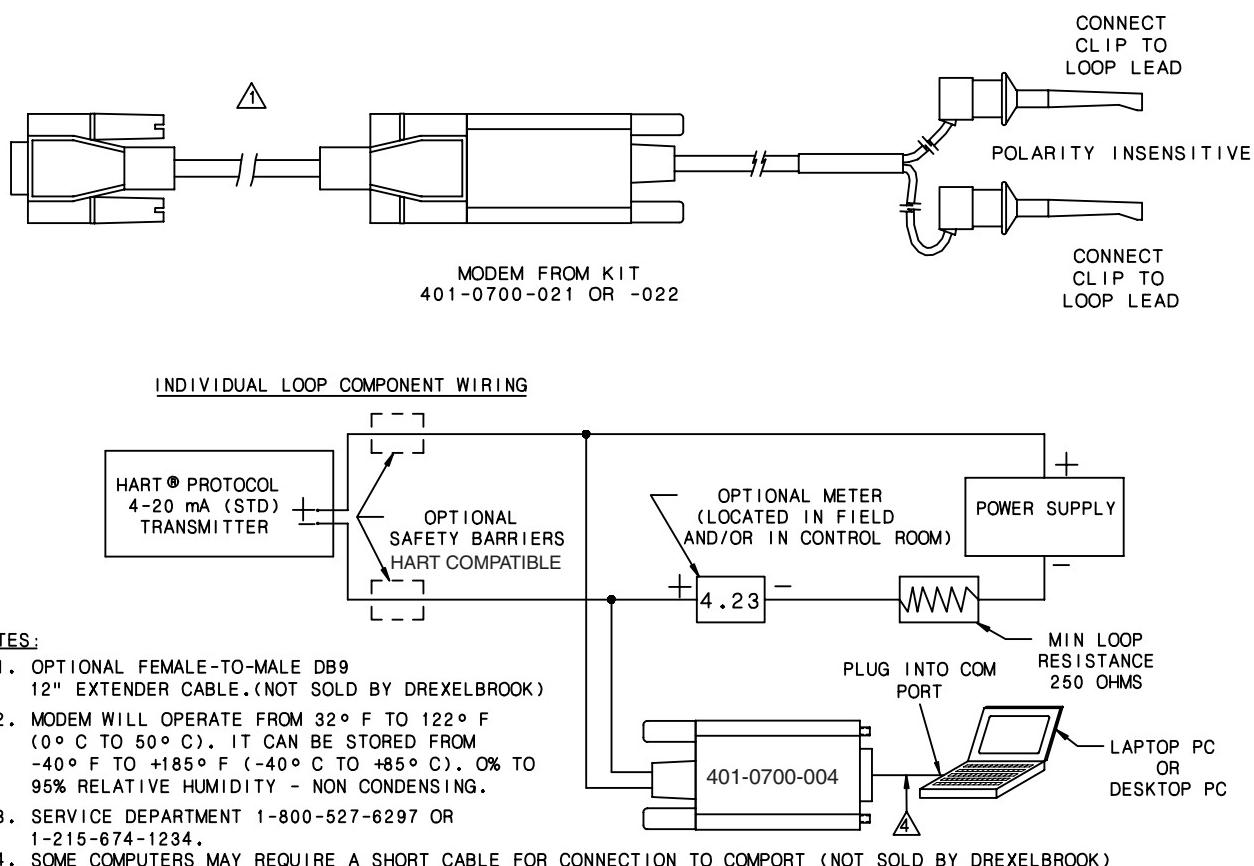


Figure 5-1
RS232 Modem Assembly & Loop Connection

5.5 Installing The USB Modem

Refer to Figure 5-1a for a connection diagram and use the following procedure to install the hardware that is necessary to run the PC software.

1. Turn on the computer
2. Install Modem Software:

It is highly recommended the USB drivers be installed BEFORE you plug in the modem.

Install the USB Drivers by inserting the Modem Installation Disk into CD Drive of the computer.

If program does not "Auto-Run", select "D:\setup" (where D is the letter representing the CD Drive)

Be Sure to Select the USB interface in the setup prompt.

Follow any "On-Screen" Instructions.

3. Connect the Drexelbrook Modem 401-700-007 to a **USB** port on the computer. With the USB drivers already installed, the computer will detect the modem and assign a COM PORT number.
4. Connect the Modem's 4-20 loop connectors to the transmitter loop.

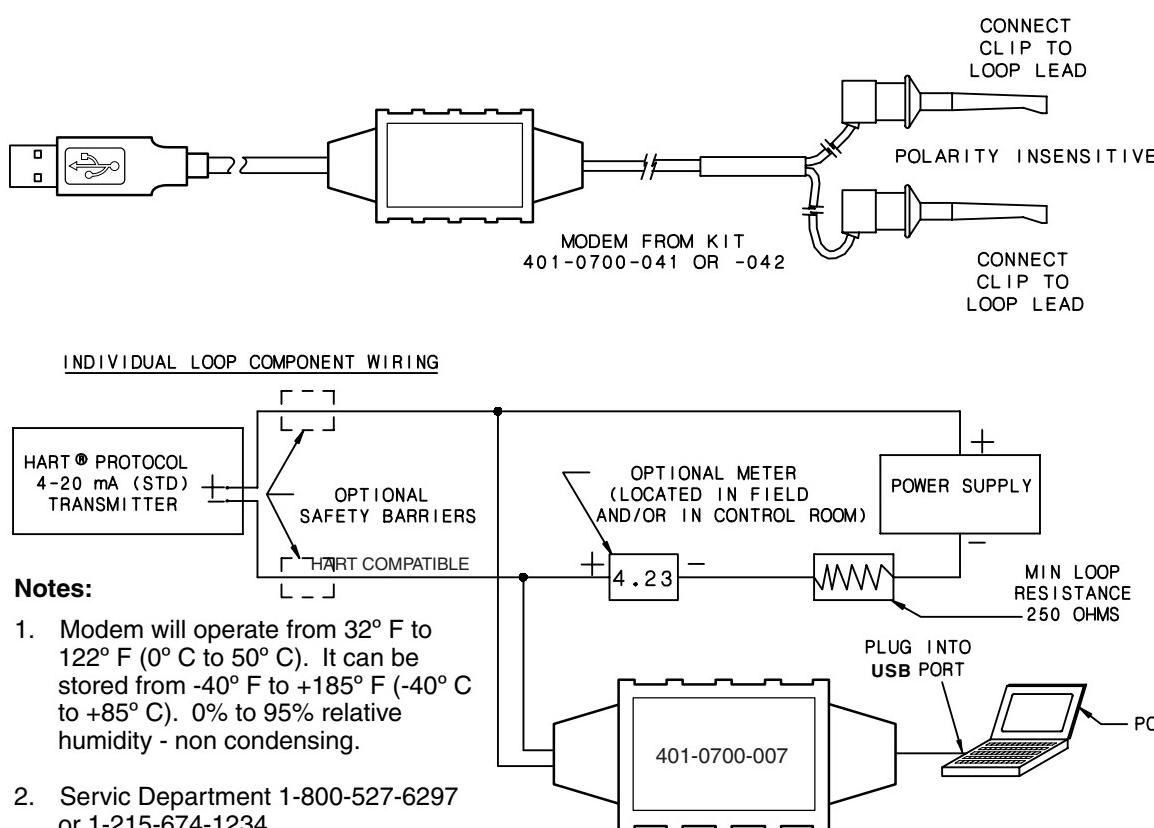


Figure 5-1a
USB Modem Assembly & Loop Connection

5.6 Install the Windows Version HARTWin™ Software on Hard Drive

Installation is simple.

1. Place the 401-700-031 CD into the CD drive (usually drive D:).
2. If program does not "Auto-Run", select "D:\setup" (where D is the letter representing the CD Drive).
3. Follow "On-Screen" instructions in **Setup** to create program file.
4. Once loaded, double click "HartWin" icon and the program should run under its own window.
5. Select communication port [**Com 1, Com 2, etc.**] then click "**OK.**"

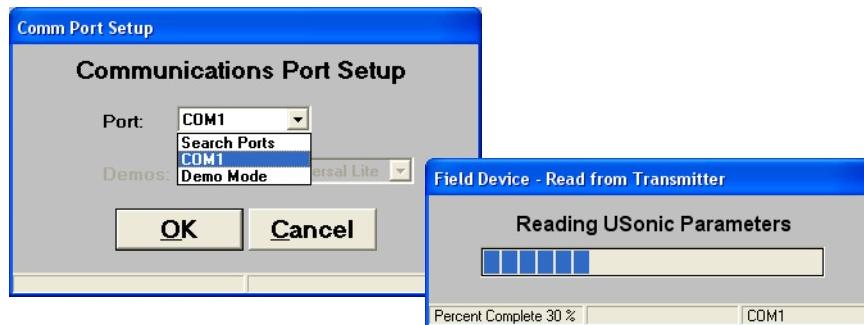


Figure 5-2
Selecting COM Ports

6. If you are not sure which communication port you are using (such as when first using a USB modem), select "Search Ports," then OK. The software automatically will seek out the correct one. In either case the software begins to communicate with the HART protocol transmitter and returns with a view (below) containing "name plate data," Tag ID and all default or existing configuration information. This is the same as if you clicked on the Read Transmitter function button.
7. The next view appears automatically, displaying current transmitter database for calibration set-up for your selected Tag ID. The Scratch Pad will automatically show the last message (last user, last calibration, etc.) up to 32 characters. If this is a new transmitter, the Tag ID is user-defined. Serial number, transmitter software version, range, etc. is automatically entered from the "name plate data" embedded in the transmitter.

5.7 Description of Function Keys



Figure 5-3
HARTWin™ Function Keys

HARTWin™ automatically communicates all "Name Plate Data" from the transmitter

The following paragraphs describe the function buttons. The data fields are described in Section 3.7- Configuration.

Read Transmitter [F3 on keyboard]

Reads all pertinent data from the transmitter and displays it on the screen. The Read function also updates the real time window. Keep in mind that it takes several seconds to load the information from the transmitter. When the load is complete, the screen shows the transmitter parameters. This command is also used when connecting to another transmitter.

Write to Transmitter [F5 on keyboard]

Sends new or edited configuration data to the transmitter. Data fields that have been edited but not sent to the transmitter are displayed in red.

Real Time View [F4 on keyboard]

Displays the real time values of Level, Volume, Distance, Temperature, Loop Current, percentage, and Status.

Point Calibration [F6 on keyboard]

Calibrates the USonic™ transmitter using Point calibration.

D/A Trim

Allows a field reference meter to be connected to the transmitter for adjusting transmitter output current.

Strapping Table

Displays the values of the Input to Level or Head, and Output to Volume or Flow in percent in a 21-Point table. Allows points to be changed to accommodate Irregularly Shaped Vessels and Custom Flumes.

Configure Meter

Configures the Display used for local indication.

USonic™ Configuration

Provides necessary configuration parameters for the Ultrasonic measurement.

Repetition Rate - Near Zone Fault Current - Lost Echo Current - Gain Mode - Variable Gain.

5.8 Configuration

Configuration involves uploading information to the transmitter that is specific to the application being measured. Ex. Flow, Level, Distance, or Volume.



Figure 5-4
Selecting Configuration

1. Begin configuration by using **Tag ID** (8 characters) or **Long Tag** (32 characters) to identify the unit or vessel. Use the **Scratchpad** (32 characters) to record the date of calibration or other similar notes. Press Tab or Enter on your keyboard.
2. Select **Level**, **Distance**, **Volume**, or **Flow** in the **Analog Loop Assign** selection box. Press Tab or Enter on your keyboard.
 - **Level Configuration** sets the output to follow the level of the material being measured.
 - **Distance Configuration** sets the output to follow the distance from the face of the transducer.
 - **Volume Configuration** sets the output to follow the strapped volume in the vessel. For example, gallons in a horizontal vessel.
 - **Flow Configuration** sets the output to follow the flow of a flume or weir. Ex. Gallons per Minute, using a parshall flume.
3. Edit **Damping Time** from 0-90 seconds, if desired.
4. Click on **Write to Transmitter**.
5. Move to **Level Configuration** section of menu.

5.8.1 Level Configuration

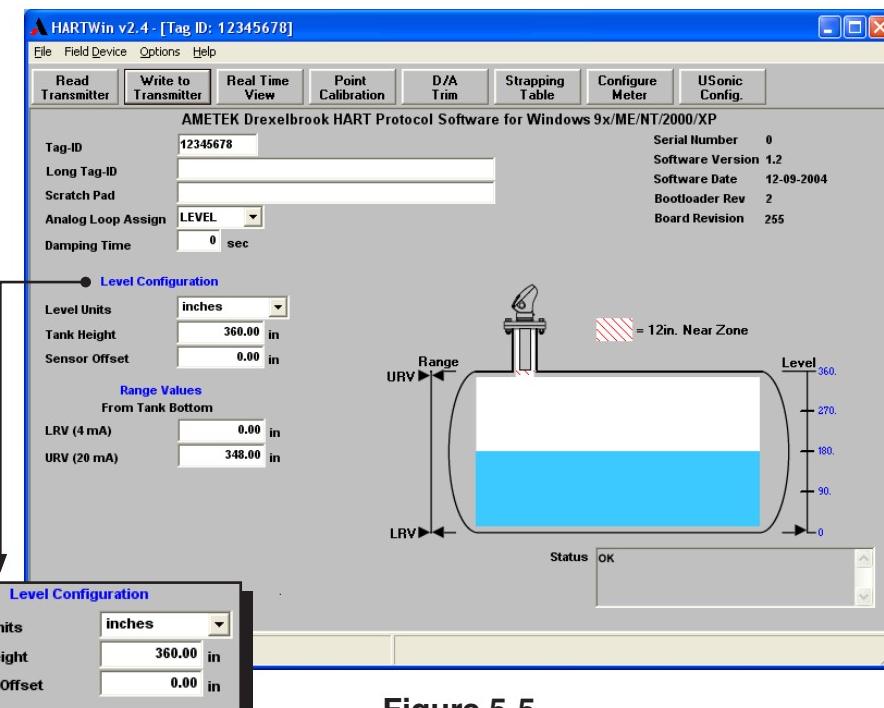


Figure 5-5
Level Configuration Menu

1. Select **Level Units**. The default is Inches. Choose the units that correspond to the level measurement.
2. Edit the **Tank Height** to agree with the actual tank height (not the length of the sensing element).
3. Enter a **Sensor Offset Value**.

The software calculates the maximum tank volume based on the value entered in the **Tank Height** field. With **0.0** entered as the **Sensor Offset** value, the software assumes the transducer face is mounted flush with the top of the tank (**Tank Height**).

Sensor Offset is used to tell the software the amount above or below the top of the tank that the transducer is located in order to calculate the tank volume.

5.8.1 Level Configuration (Continued)



Sensor Offset can be applied in cases where:

- The transducer protrudes below the top of the tank or,
- The transducer is mounted above the top of the tank or,
- A pipe extension is installed to raise the transducer face 12 inches above the tank height to compensate for the 12-Inch Near Zone.
- See **Figure 5-5**
- If the transducer is mounted above the top of the vessel, a positive value is entered in Sensor Offset .
- If the transducer is mounted below the top of the tank, a negative value is entered in **Sensor Offset**.

4. Click on **Write to Transmitter**.

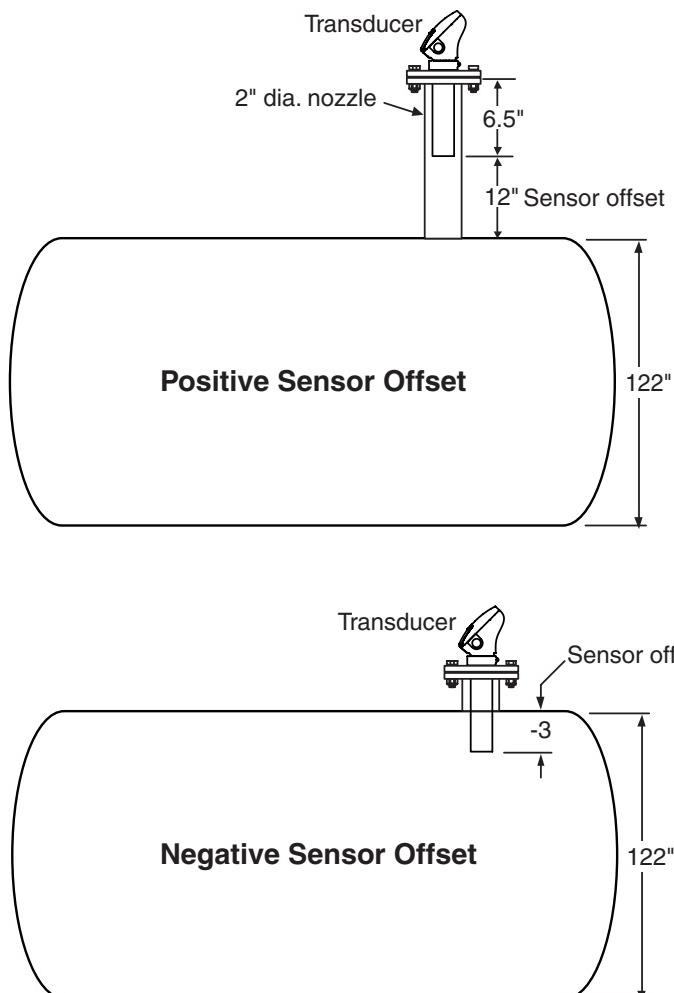


Figure 5-5
Sensor Offset

5.8.2 Distance Configuration

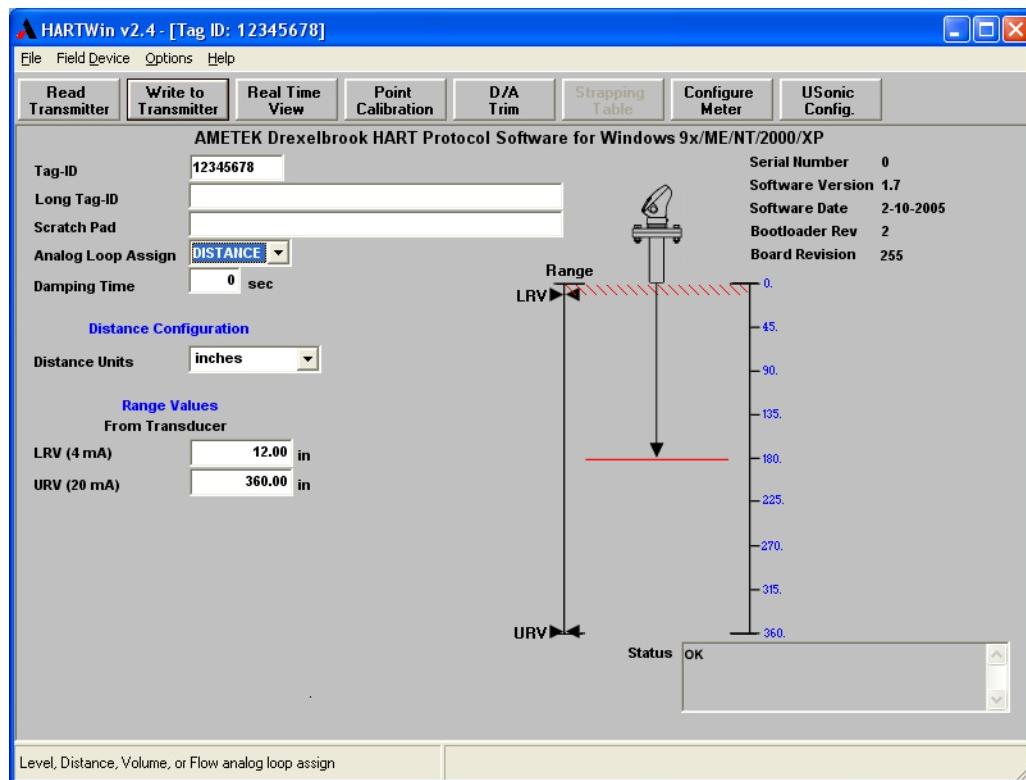


Figure 5-6
Distance Configuration Menu



1. Select Distance Units.

The default is Inches.

Press Enter and Choose the units that correspond to the Distance Measurement.

2. Choose Write to Transmitter.

5.8.3 Volume Configuration

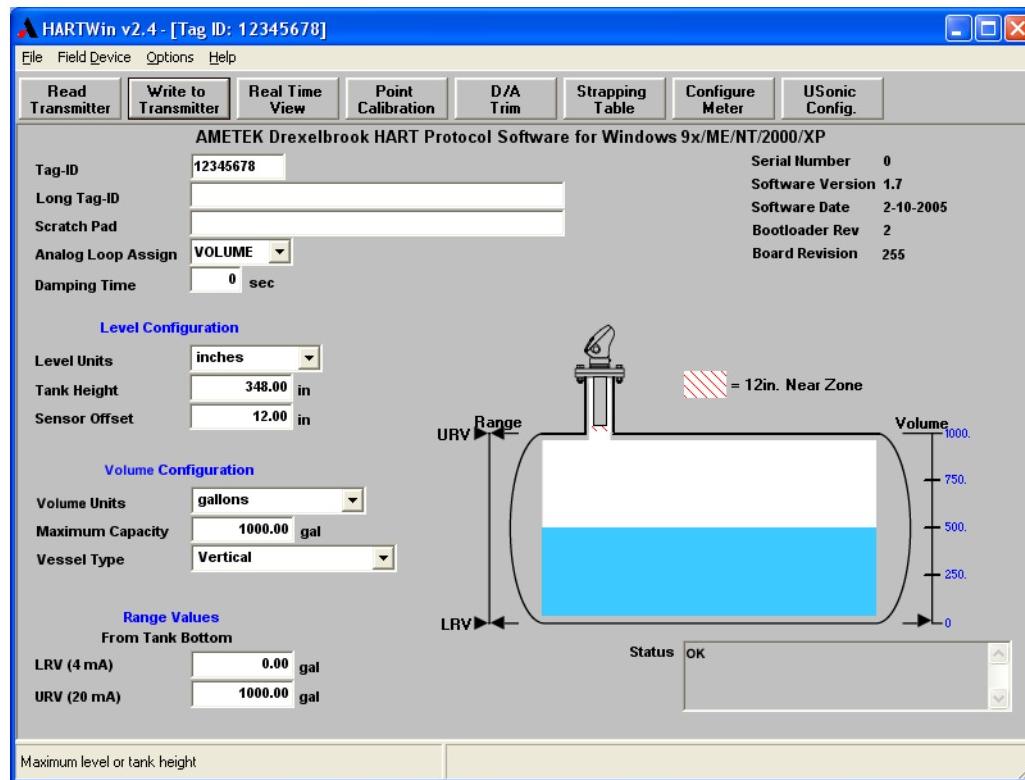


Figure 5-7
Volume Configuration Menu

1. Select **Volume Units**. The default is gallons. Press **Enter** and choose the units that correspond to the volume measurement.
Default selection is gallons .
Press **Tab** or **Enter**.
 2. Edit the **Maximum Capacity** of the vessel. Enter 100 for percent if the volume units are not known or needed.
Press **Tab** or **Enter**.
 3. Select **Vessel Type**. Default selection is Vertical.
-  If a Custom Vessel Type is required, select **User Defined**.
See Section 5.8.9
4. Click on **Write to Transmitter**.



5.8.4 Flow Configuration

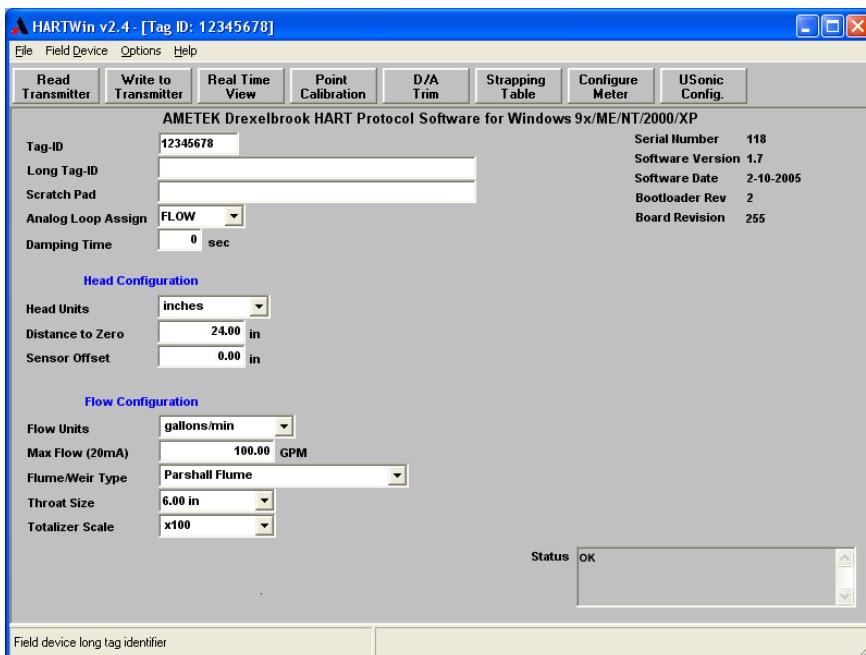


Figure 5-8
Flow Configuration Menu



1. Select **Head Units**. The default selection is Inches.
2. Enter Distance to Zero (The value that defines the distance from the Transducer Face to the bottom of the Flume / Weir at Zero Flow). This value also corresponds to the 4 mA (0% of Range) point.
3. Enter the Sensor Offset Value. **See Section 5.8.1**



4. Select **Flow Units**. The default value is "Gallons Per Minute". Press Enter and choose the units that correspond to the Flow Measurement.
5. Edit the Max. Flow - The Maximum Flow corresponds to the 20 mA (100% of Range) Point.

6. Select the **Flume/Weir Type**. The default selection is Parshall Flume.

If none of the selections are appropriate for the application, Select **User Defined**. A Custom Strapping Table will need to be created. **See Section 5.8.9**

7. Edit or select the appropriate **Flume/Weir Size**.



A Selection Box or Edit Box will appear, depending on the Flume / Weir selected. If an Edit Box appears, the selected Flume / Weir supports any size. **See Section 1.5**

8. Click on Write to Transmitter.

5.8.4 Flow Configuration (Continued)

Totalizer Configuration (Available Only when Flow Measurement is Selected)

1. Select Totalizer Scale

Default value is x 100.

Select the scale of the total flow to be displayed.

2. Reset the Totalizer

This resets the second total flow.

Select **Field Device - Reset Total Flow** in the HARTWin Menu.

5.8.5 Lower Range Value (LRV) and Upper Range Value (URV)

LRV and URV may be referenced from the following:

Level Configuration - Tank Bottom

Distance Configuration - Transducer Face

Volume Configuration - Tank Bottom

Flow Configuration - LRV = Zero Flow / URV = Max Flow

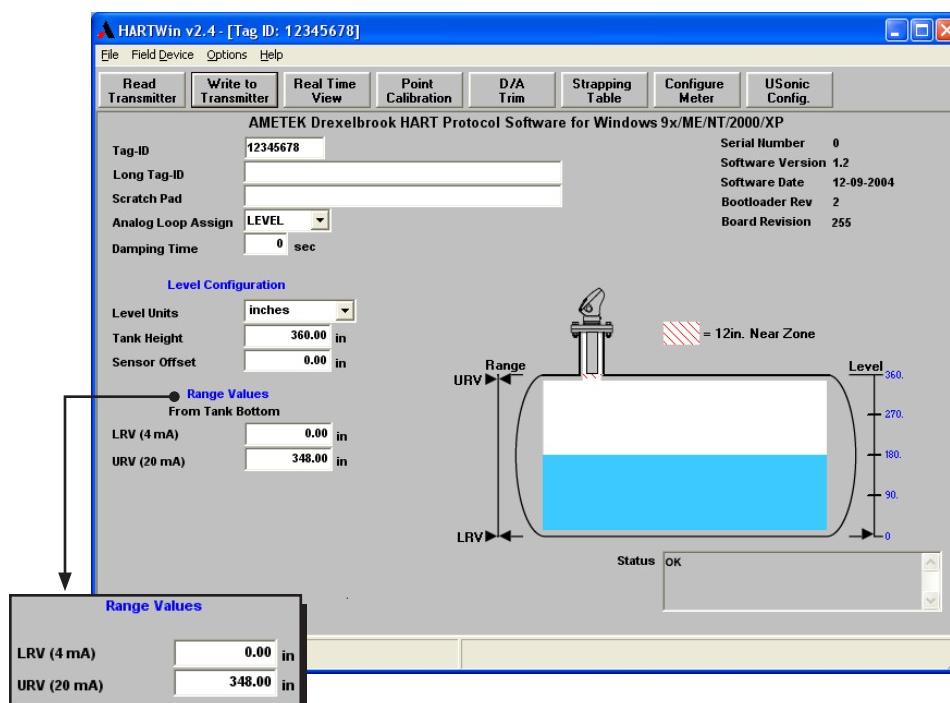


Figure 5-9
Entering LRV and URV Values

1. Enter a Lower Range Value.

LRV - The 4 mA point, or 0% of Range.

2. Enter an Upper Range Value.

URV - The 20 mA point, or 100% of Range.

3. Click on Write to Transmitter.

5.8.5 LRV and URV (Continued)

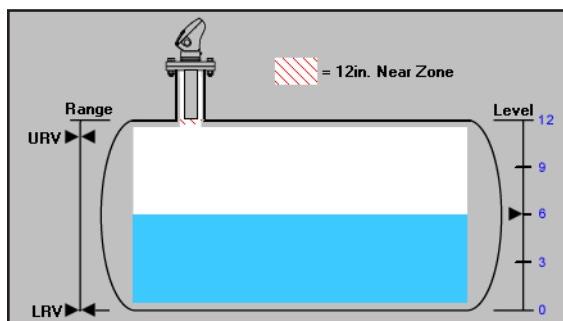
Entering LRV and URV in the Level Mode

Example #1

Tank is 12 feet tall. Set **Tank Height** to 12 feet.

LRV (4 mA point) is 0 feet (bottom of tank).

URV (20 mA point) is 11 feet. (Bottom of tank to transducer face minus 12 inch near zone.)



Example #2

Tank is 31 feet tall (one foot farther than range of transmitter). Set **Tank Height** to 31 feet.

LRV (4 mA point) is 1 foot. (Tank height of 31 feet minus maximum range of 30 feet equals 1 foot.)

URV (20 mA point) is 30 feet (Bottom of tank to transducer face minus 12 inch near zone.)

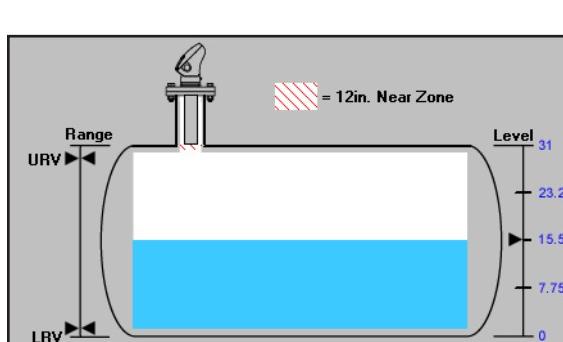


Figure 5-10
LRV and URV Values

5.8.6 Ultrasonic Configuration

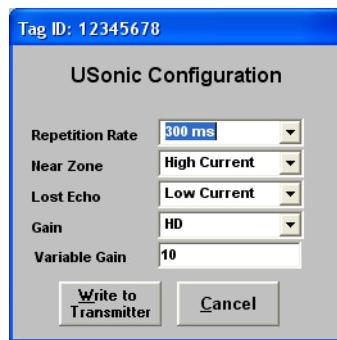


Figure 5-11
Ultrasonic Configuration Menu

Repetition Rate

An application might require a longer repetition rate, depending on the type of vessel and material being measured.

For instance:

- Increasing the repetition rate to 400 ms is required any time that the tank roof is curved. A longer repetition rate ensures that transmitter is not affected by reflected sound waves from the curved roof.
- A lengthened repetition rate also helps reduce loss of echo due to foam.

Near Zone and Lost Echo Fault Outputs

Select the output current of a Near Zone and Lost Echo fault condition.

Low Current: 3.7 mA

High Current: 22 mA



Application Notes for Near Zone and Lost Echo Settings

- Application requires Overfill Prevention (no spills)
Material cannot go over high point
Near Zone typically set 22 mA
Lost Echo typically set 22 mA
- Application requires Low Level Prevention (pump will not run dry)
Material cannot go below low point
Near Zone typically set 22 mA
Lost Echo typically set 3.7 mA

5.8.6 Ultrasonic Configuration (Continued)

Gain

Select the gain setting for the ultrasonic instrument.

HD (High Discrimination)

- High discrimination mode automatically reduces the effect of nuisance echos created when mounting the transducer in a nozzle or mounting the transducer inside a pipe up to 14 inches above the tank opening.
- The high discrimination mode reduces any effect from agitator blades and/or small obstructions. It also reduces system interference caused by electrical noise.
- The high discrimination mode should not be used in applications where foam is present.

Standard Gain

- Accesses step gain selection.
 - The step gain settings can be used to decrease the ultrasonic return signal and avoid noise interference.
 - For example, the power produced to shoot the 30-Foot signal could possibly cause nuisance reflections from irregular sidewalls, tank obstructions, or agitator blades. By reducing the gain of the transmitter using the step gain settings, the effect of nuisance reflections can be eliminated.
1. Click on Write to Transmitter to save the configuration.
 2. Click Cancel to exit USonic configuration.
 3. USonic configuration is now complete.

5.8.7 Point Calibration

Point calibration increases the accuracy of the measurement and compensates for atmospheres other than air by using the actual distance to the Transducer Face for calibration.

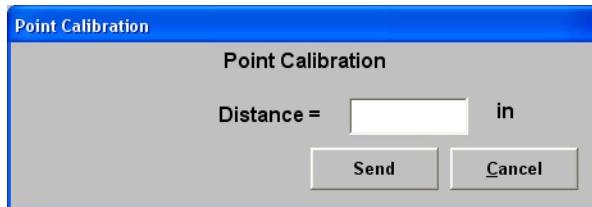


Figure 5-12
Point Calibration Menu

1. Measure the distance from the Transducer Face to the surface of the material being measured. For best results, the material should be lowered to the bottom of the vessel.
2. Click on **Point Calibration**
3. Enter the actual distance.

The Actual Distance entered cannot exceed +/-25% of the factory setting.

Example: If the transmitter was indicating a distance of 60".
The minimum Actual Distance entered can be no less than 45".
The maximum Actual Distance entered can be no greater than 75".

4. Click on **Send**

5.8.8 Configure Meter

The 7-Digit Display can be configured to display Status Messages and any Calculated Value. (4-20 mA, % of Range, Distance, Temp., etc.)

The Configure Meter Function allows the user to select the values that can be viewed on the display. Pressing the Up or Down Buttons on the keypad will allow the user to scroll through all of the enabled values.



Percent of Range is always enabled.

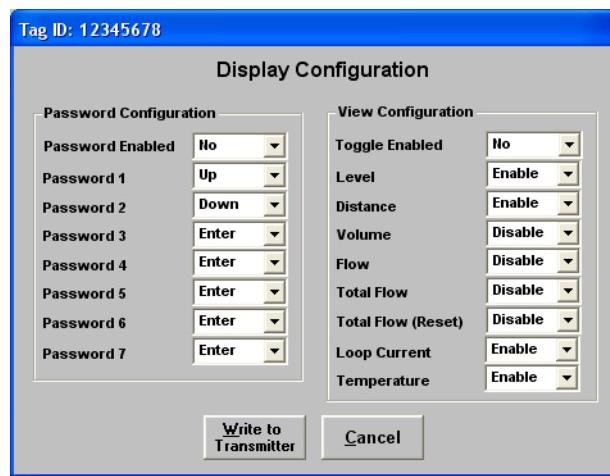


Figure 5-13
Display Configuration

View Configuration

- **Toggle Enabled** - This Enables or Disables the Auto-Scrolling feature of the display.
- If this function is Enabled, all of the Enabled Views will automatically scroll every 10 seconds.



This would be useful if the user was unable to reach the keypad to scroll manually.

5.8.8 Configure Meter (Continued)

Password Configuration

Password Enabled

This Enables or Disables the Password Required to enter the Menu.

Password 1-7

This selects the keypad sequence values of the password to enter the menu on the display.

Password 1 is the value for the first keypress.

Password 7 is the value for the last keypress.

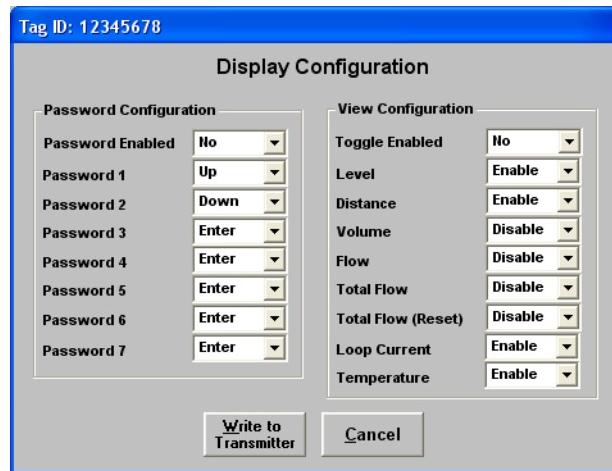


Figure 5-13
Display Configuration



Example:

Figure 5-13 shows a keypress sequence of:

Up - Down - Enter - Enter - Enter - Enter - Enter.

This would be the sequence required to Enter the Menu on the display if the password was enabled.

5.8.9 Strapping Table

The Strapping Table is a 2-21 Point, table used to create a Custom non-linear output relationship to Level or Head Height.

Flow Applications

Several pre-defined Flume/Weir types are available **See Section 5.8.4**. If none of the pre-defined Flume / Weir types are appropriate for the application, a Custom Strapping Table will be necessary.

Volume Applications

Several pre-defined vessel types are available **See Section 5.8.3**. If none of the pre-defined vessel types are appropriate for the application, a Custom Strapping Table will be necessary.

Level

IN	Percent	OUT	Percent
0.00	0.00	0.00	0.00
17.40	5.00	50.00	5.00
34.80	10.00	100.00	10.00
52.20	15.00	150.00	15.00
69.60	20.00	200.00	20.00
87.00	25.00	250.00	25.00
104.40	30.00	300.00	30.00
121.80	35.00	350.00	35.00
139.20	40.00	400.00	40.00
156.60	45.00	450.00	45.00
174.00	50.00	500.00	50.00
191.40	55.00	550.00	55.00
208.80	60.00	600.00	60.00
226.20	65.00	650.00	65.00
243.60	70.00	700.00	70.00
261.00	75.00	750.00	75.00
278.40	80.00	800.00	80.00
295.80	85.00	850.00	85.00
313.20	90.00	900.00	90.00
330.60	95.00	950.00	95.00
348.00	100.00	1000.00	100.00

Number of Points
21

Last Read Values

Write Strapping Table

Load Standard Table

Exit

Figure 5-14
Strapping Table for Volume

Load Standard Table (Volume Only)

If the application does not match one of the pre-defined vessel types, but the application is similar, a pre-defined vessel type may be loaded into the Strapping Table for custom editing.

To load a pre-defined Vessel Type into the Strapping Table:
Press the “**Load Standard Table**” button within the Strapping Table Window and select the desired vessel.

Pre-defined Vessel Types:

- Linear (Vertical Tank)
- Horizontal Tank with Flat Ends
- Horizontal Tank with Hemispherical Ends
- Spherical Tank

5.8.9 Strapping Table (Continued)

Plan your table by filling out the table below.

- Use the first column which lists every 5% between 0 and 100% or
Fill in your own values in column 2.
- Fill out column 3 with output values corresponding to those listed in column 1 or 2.

Point	% Level/Head Standard Preset Values	% Level/Head Optional Values	Output Values Selected Units
1	0		
2	5		
3	10		
4	15		
5	20		
6	25		
7	30		
8	35		
9	40		
10	45		
11	50		
12	55		
13	60		
14	65		
15	70		
16	75		
17	80		
18	85		
19	90		
20	95		
21	100		

Section 6: System Specifications

6.1 Transmitter Specifications

Power Requirement:

12.0 to 30 Vdc - Voltages in excess of 30 Vdc will cause permanent damage.

$$\text{Load Resistance} = \text{V supply} - 12.0 / 0.02$$

- Minimum supply voltage is 19 volts at 4 mA
- For example:

V supply = 24 V and maximum load resistance = 600 ohms.

Ambient Operating Temperature

Electronics: -40°F to 158°F (-40°C to 70°C)

LCD Display: -4°F to 158°F (-20°C to 70°C)

Ambient Temperature Effect:

+/- 0.1% per 1°F

Repeatability:

0.1 inch (3 mm)

Resolution:

0.125 inch (3 mm)

Response Time:

Less than 1 second

Calibration:

Zero & Span: to nearest .01 inch (3 mm)

Near Zone: 12 inches (305 mm)

Minimum span: 3 inches (76 mm)

Maximum span: 30 feet (9.1 m)

Output:

2-wire signal loop: 4 – 20 mA DC (isolated)

Accuracy:

0.15% of maximum sensor range

Temperature Compensation:

Automatic

Damping:

0 to 90 seconds

Lost Echo:

22 mA or 3.7 mA – field selectable

Near Zone:

22 mA or 3.7 mA – field selectable

Pulse Repetition Rate:

300 or 400 msec – field selectable

Fail Safe:

22 mA

6.2 Transducer Specifications

Sensor

Material: CPVC

Pressure: -10 to 50 psig

2" NPT / BSP Process Connection

Operating Temperature:

-40 to 158°F (-40°C to 70°C)

Beam Angle:

Conical, 10° typical, at the 3 db down point

6.3 Enclosure Specifications

US - 1X PBT-RF (Valox 420 SEO UV Stabilized) to NEMA 4X (IP 66)
3/2" NPT / M20 Electrical/Conduit Entries

US - 2X Cast Aluminum Rated to NEMA 4X, IP 66, IP 68 (3m / 72h)
3/4" Electrical / Conduit Entries

6.4 Approvals

FM / FMc

Model US-11, US-12

Intrinsically Safe for use in Class I, II and III, Division 1, Groups A, B, C, D, E, F and G and Class I, Zone 0, AEx / Ex ia, Group IIC in accordance with Entity requirements and Control Drawing 420-0004-289-CD; Nonincendive for use in Class I, Division 2, Groups A, B, C and D and Class I, Zone 2, Group IIC; Suitable for use in Class II and III, Division 2, Groups F and G; Dust-Ignitionproof for use in Class II and III, Division 1, Groups E, F and G Indoor and Outdoor, Type 4, 4X IP65 Hazardous (Classified) Locations.

Model US-21, US-22

Intrinsically Safe for use in Class I, II and III, Division 1, Groups A, B, C, D, E, F and G and Class I, Zone 0, AEx / Ex ia, Group IIC in accordance with Entity requirements and Control Drawing 420-0004-272-CD: Nonincendive for use in Class I, Division 2, Groups A, B, C and D; Suitable for use in Class II and III, Division 2, Groups F and G; Dust-Ignitionproof for use in Class II and III, Division 1, Groups E, F and G;

Explosionproof for use in Class I, Division 1, Groups A, B, C and D Indoor and Outdoor, Type 4, 4X, IP 66, IP 68 (3m / 72h) Hazardous (Classified) Locations.

6.4 Approvals (Continued)

IECEx

Ex ia IIC T5

FMG05.0001X

IEC – 60079 – 0 – General Requirements 2004-04

IEC – 60079 – 11 – Intrinsic Safety 1999-04

Install per 420-0004-312-CD

ATEX-NEMKO

II 1 G Ex ia IIC T5 US2X - IP66, IP68

NEMKO 05 ATEX 1271X

EN 60079-0:2006

EN 60079-11:2007

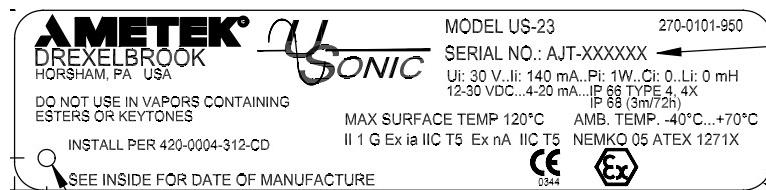
EN 60079-26:2004

The insulation between the intrinsically safe circuit and the frame of the electrical apparatus or parts which may be earthed are capable of withstanding 500 vac.

Install per 420-0004-312-CD

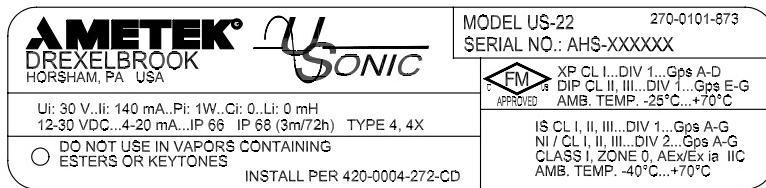
6.4 Approvals (Continued)

US23, ATEX Label

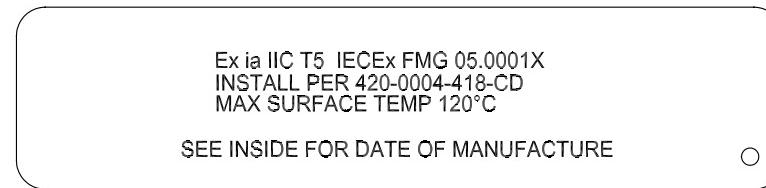


US22, FM Label

FRONT SIDE



BACK SIDE



Section 7: Control Drawings / General Safety Information

7.1 General Safety Information

This document contains installation instructions for potentially explosive atmosphere applications.

The USonic is approved for use in hazardous locations when properly installed. Control drawings detailing installation guidelines are available in this section.

Always Install to Local Codes / Requirements / Directives as Mandated by the Authority Having Jurisdiction.

The aluminum enclosure on Model US2 must be protected from mechanical friction and impact that could cause ignition capable sparks.



Warning

Installation, Start-Up, and Service should only be performed by personnel trained in explosive atmosphere installations.

Substitution of Components May Impair Intrinsic Safety.

7.1.1 Device Description

The USonic is a Continuous Level Measurement System.

Measurements are displayed via remote communications or an integrated display screen.

Electrical connection

WARNING! Read the following information carefully.

Live Maintenance should only be carried out by Skilled Personnel trained in explosion protection methods.

Test Equipment used to perform “Live Maintenance” must be certified to use in the associated hazardous area.

7.1.2 Intrinsically Safe Installations

When the USonic is installed as an intrinsically safe device per the agency control drawings, the housing cover may be safely opened. For system configuration, remove the view port housing cover to access the display keypad for local system configuration.

7.1 General Safety Information (Continued)

7.1.3 Explosionproof or Flameproof Installations (Model US2)

No Live maintenance is permitted.

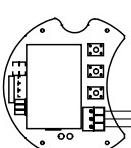
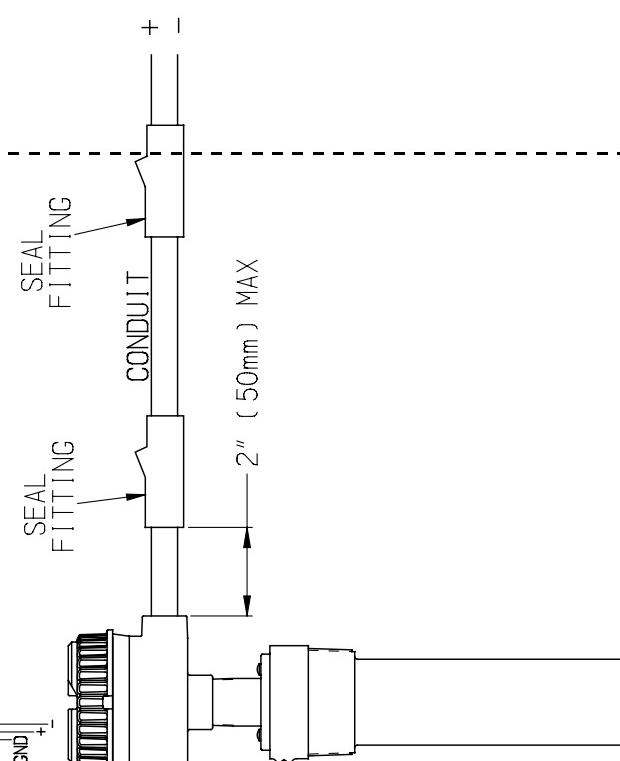
Disconnect power to the device and check that the atmosphere is clear of hazardous substances.

7.1.4 Start-up checklist

Do not connect power until you have gone through the checklist below

1. Are the wetted components (gasket, flange and sensing element) resistant to the corrosive properties of the tank product?
2. Does the information given on the nameplate correspond with the application?
3. Ex i applications: Are you using an intrinsic barrier within the correct parameters?
4. Did you install cable entries of the correct internal diameter so that there is a good seal around the cable? Are the cable glands suitably certified per the application and the hazardous area parameters?

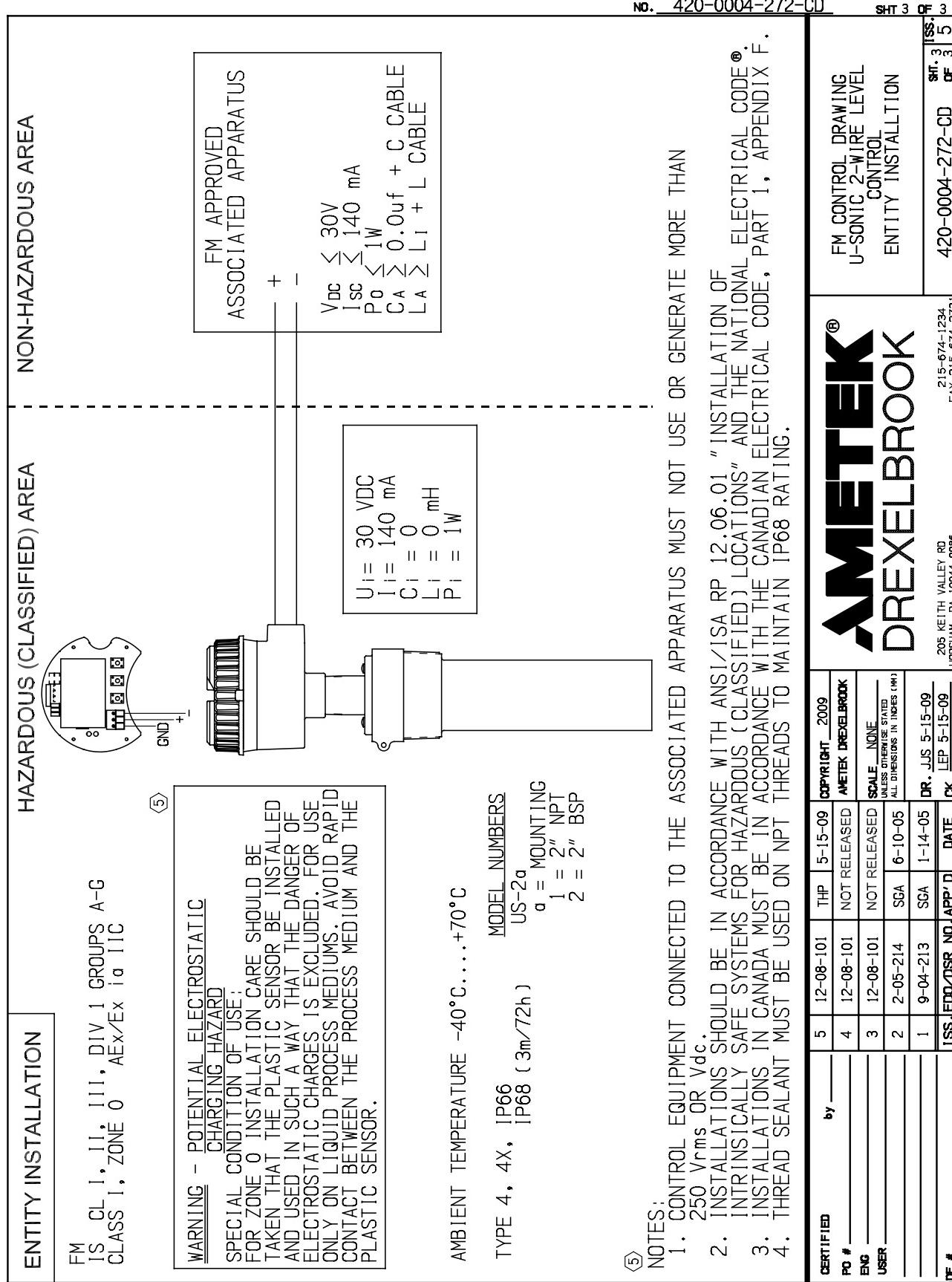
7.2 FM Control Drawings

EXPLOSIONPROOF INSTALLATION <p>FM XP CL I, DIV 1, GROUPS A-D DIP CL II, III; DIV 1, GROUPS E-G</p>	HAZARDOUS (CLASSIFIED) AREA  <p>TYPE 4, 4X, IP66, IP68 (3m/72h)</p> <p>AMBENT TEMPERATURE -25°C. . . +70°C</p> <p>MODEL NUMBERS US-2^a a = MOUNTING 1 = 2" NPT 2 = 2" BSP</p> <p>⑤</p>	NON-HAZARDOUS AREA  <p>NOTES: 1. INSTALLATIONS MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE ® ANSI/NFPA 70. 2. CONDUIT SEAL MUST BE 2" (50mm) MAXIMUM FROM ENCLOSURE. 3. FOR EXPLOSIONPROOF (XP) INSTALLATIONS. DO NOT USE IN VAPORS CONTAINING ESTERS OR KEYTONES. 4. DUST TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS. 5. THREAD SEALANT MUST BE USED ON NPT THREADS TO MAINTAIN IP68 RATING. 6. INSTALLATIONS IN CANADA MUST BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE, PART 1, APPENDIX F. 7. NO REVISION TO THIS DRAWING IS PERMITTED WITHOUT FM APPROVAL.</p>
		NO. <u>420-0004-272-CD</u> SHT 1 OF 3 ISS. 1 SS. 1 DE # 5 FM CONTROL DRAWING U-SONIC 2-WIRE LEVEL CONTROL EXPLOSIONPROOF INSTALLATION W/O BARRIER 215-674-1234 FAX 215-674-2731 420-0004-272-CD SHT 1 OF 3 ISS. 1 SS. 1 DE # 5 AMETEK® DREXELBROOK 205 KEITH VALLEY RD HORSHAM, PA 19044-3986

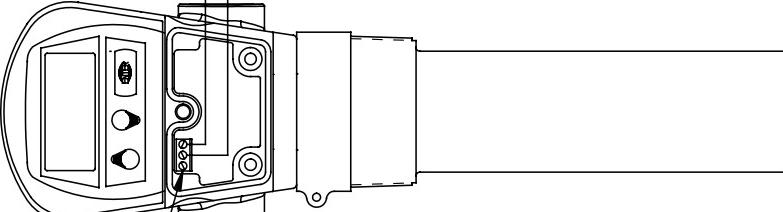
7.2 FM Control Drawings (Continued)

<p>DIV 2 W/O BARRIER INSTALLATION</p> <p>FM NI / CL I, II, III...DIV 2...GROUPS A-G</p> <p>TYPE 4, 4X, IP66, IP68 (3m/72h)</p> <p>AMBIENT TEMPERATURE -40°C...+70°C</p> <p>MODEL NUMBERS</p> <p>US-2^a a = MOUNTING 1 = 2" NPT 2 = 2" BSP</p>	<p>HAZARDOUS (CLASSIFIED) AREA</p> <p>NON-HAZARDOUS AREA</p> <p>FOR NON-INCENDIVE FIELD WIRING INSTALLATIONS</p> <p>FM APPROVED NON-INCENDIVE FIELD WIRING APPARATUS</p> <p>CONDUIT OR NON-INCENDIVE FIELD WIRING</p> <p>U_i = 30 VDC I_i = 140 mA C_i = 0 L_i = 0 P_i = 1W</p> <p>V_{oc} ≤ 30 VDC I_{sc} ≤ 140 mA P_o ≤ 1W C_A ≥ 0.0uF + C CABLE L_A ≥ L_i + L CABLE</p>																				
<p>(5)</p> <p>NOTES:</p> <ol style="list-style-type: none"> 1. INSTALLATIONS MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE ® ANSI/NFPA 70. 2. DUST TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS I AND CLASS III ENVIRONMENT. 3. INSTALLATIONS IN CANADA MUST BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE, PART 1, APPENDIX F. 4. THREAD SEALANT MUST BE USED ON NPT THREADS TO MAINTAIN IP68 RATING. 																					
<p>NO. 420-0004-272-CD SHT 2 OF 3 ISS. 5</p> <p>FM CONTROL DRAWING U-SONIC 2-WIRE LEVEL CONTROL DIVISION 2 WITHOUT BARRIER</p> <p>AMETEK® DREXEL BROOK</p> <p>215-674-1234 FAX 215-674-2731</p> <p>205 KEITH VALLEY RD HORSHAM, PA 19044-9986</p> <p>ISS. 2 ED0/DSR NO. APP' D DATE CK. LEP 5-15-09</p> <p>CERTIFIED by _____ Date 5-15-09 COPYRIGHT 2009</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>PO # _____</td> <td>4 12-08-101</td> <td>NOT RELEASED</td> <td>AMETEK DREXEL BROOK</td> </tr> <tr> <td>ENG _____</td> <td>3 12-08-101</td> <td>NOT RELEASED</td> <td>SCALE: NONE UNLESS OTHERWISE STATED</td> </tr> <tr> <td>USER _____</td> <td>2 2-05-214</td> <td>SGA 6-10-05</td> <td>ALL DIMENSIONS IN INCHES (MM)</td> </tr> <tr> <td>DE # _____</td> <td>1 9-04-213</td> <td>SGA 1-14-05</td> <td>DR. US 5-15-09</td> </tr> <tr> <td colspan="2"></td> <td>DR. LEP 5-15-09</td> <td>CK. LEP 5-15-09</td> </tr> </table> <p>420-0004-272-CD SHT 2 OF 3 ISS. 5</p>		PO # _____	4 12-08-101	NOT RELEASED	AMETEK DREXEL BROOK	ENG _____	3 12-08-101	NOT RELEASED	SCALE: NONE UNLESS OTHERWISE STATED	USER _____	2 2-05-214	SGA 6-10-05	ALL DIMENSIONS IN INCHES (MM)	DE # _____	1 9-04-213	SGA 1-14-05	DR. US 5-15-09			DR. LEP 5-15-09	CK. LEP 5-15-09
PO # _____	4 12-08-101	NOT RELEASED	AMETEK DREXEL BROOK																		
ENG _____	3 12-08-101	NOT RELEASED	SCALE: NONE UNLESS OTHERWISE STATED																		
USER _____	2 2-05-214	SGA 6-10-05	ALL DIMENSIONS IN INCHES (MM)																		
DE # _____	1 9-04-213	SGA 1-14-05	DR. US 5-15-09																		
		DR. LEP 5-15-09	CK. LEP 5-15-09																		

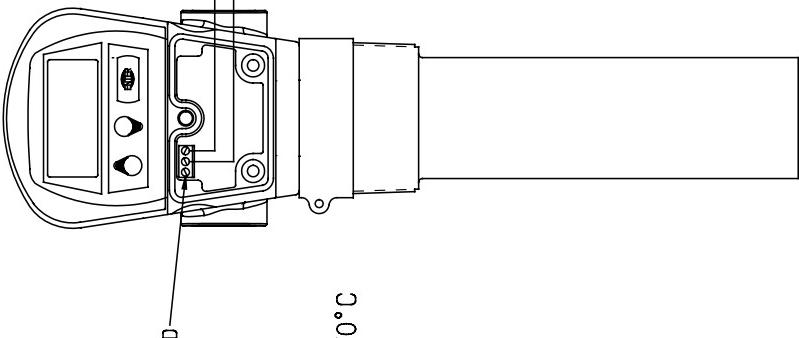
7.2 FM Control Drawings (Continued)



7.3 FMc Control Drawings

ENTITY INSTALLATION	HAZARDOUS (CLASSIFIED) AREA	NON-HAZARDOUS AREA																																												
IS CL I, III, DIV 1 GROUPS A-G CLASS I, ZONE 0 AEx/Ex ia IIC	 <p>FM APPROVED ASSOCIATED APPARATUS</p> <p>TYPE 4, 4X, IP66</p> <p>AMBIENT TEMPERATURE -40°C...+70°C</p> <p>MODEL NUMBERS</p> <p>US-1^a ^a = MOUNTING 1 = 2" NPT 2 = 2" BSP</p>	<p>FM APPROVED ASSOCIATED APPARATUS</p> <p>TYPE 4, 4X, IP66</p> <p>AMBIENT TEMPERATURE -40°C...+70°C</p> <p>MODEL NUMBERS</p> <p>US-1^a ^a = MOUNTING 1 = 2" NPT 2 = 2" BSP</p> <p>NOTES:</p> <ol style="list-style-type: none"> 1. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc. 2. INSTALLATIONS SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP 12.06.01 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" AND THE NATIONAL ELECTRICAL CODE®. 3. INSTALLATION IN CANADA SHOULD BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE, CSA C22.1, PART i. 4. NO REVISION TO THIS DRAWING IS PERMITTED WITHOUT FM APPROVAL. 																																												
		<table border="1"> <tr> <td>CERTIFIED</td> <td>by _____</td> <td>COPYRIGHT 2009</td> <td>FM CONTROL DRAWING</td> </tr> <tr> <td>PO #</td> <td></td> <td>AMETEK DREXELBROOK</td> <td>U-SONIC 2-WIRE LEVEL</td> </tr> <tr> <td>ENG</td> <td></td> <td>SCALE: NONE</td> <td>CONTROL ENTITY INSTALLATION</td> </tr> <tr> <td>USER</td> <td></td> <td>UNLESS OTHERWISE STATED</td> <td>US-1X SERIES</td> </tr> <tr> <td>DE #</td> <td></td> <td>ALL DIMENSIONS IN INCHES (MM)</td> <td></td> </tr> <tr> <td colspan="2">ISS. EDD/DSR NO. APP' D</td> <td>DR. J.S. 5-15-09</td> <td>215-674-1234</td> </tr> <tr> <td colspan="2"></td> <td>DR. LEP 5-15-09</td> <td>FAX 215-674-2731</td> </tr> <tr> <td colspan="2"></td> <td>DATE</td> <td>420-0004-289-CD</td> </tr> <tr> <td colspan="2"></td> <td></td> <td>SHR. 1 OF 3</td> </tr> <tr> <td colspan="2"></td> <td></td> <td>ISS. 1 OF 2</td> </tr> <tr> <td colspan="2"></td> <td></td> <td>SHR. 3 OF 3</td> </tr> </table>	CERTIFIED	by _____	COPYRIGHT 2009	FM CONTROL DRAWING	PO #		AMETEK DREXELBROOK	U-SONIC 2-WIRE LEVEL	ENG		SCALE: NONE	CONTROL ENTITY INSTALLATION	USER		UNLESS OTHERWISE STATED	US-1X SERIES	DE #		ALL DIMENSIONS IN INCHES (MM)		ISS. EDD/DSR NO. APP' D		DR. J.S. 5-15-09	215-674-1234			DR. LEP 5-15-09	FAX 215-674-2731			DATE	420-0004-289-CD				SHR. 1 OF 3				ISS. 1 OF 2				SHR. 3 OF 3
CERTIFIED	by _____	COPYRIGHT 2009	FM CONTROL DRAWING																																											
PO #		AMETEK DREXELBROOK	U-SONIC 2-WIRE LEVEL																																											
ENG		SCALE: NONE	CONTROL ENTITY INSTALLATION																																											
USER		UNLESS OTHERWISE STATED	US-1X SERIES																																											
DE #		ALL DIMENSIONS IN INCHES (MM)																																												
ISS. EDD/DSR NO. APP' D		DR. J.S. 5-15-09	215-674-1234																																											
		DR. LEP 5-15-09	FAX 215-674-2731																																											
		DATE	420-0004-289-CD																																											
			SHR. 1 OF 3																																											
			ISS. 1 OF 2																																											
			SHR. 3 OF 3																																											

7.3 FMc Control Drawings (Continued)

DIV 2 W/O BARRIER INSTALLATION	HAZARDOUS (CLASSIFIED) AREA	NON-HAZARDOUS AREA
CL 1, DIV 2, GROUPS A-D CL 1, ZONE 2, IIC TYPE 4, 4X, IP66	 <p>AMBIENT TEMPERATURE -40°C...+70°C</p> <p>MODEL NUMBERS</p> <p>US-1.a a = MOUNTING 1 = 2" NPT 2 = 2" BSP</p>	<p>FOR NON-INCENDIVE FIELD WIRING INSTALLATIONS</p> <p>FM APPROVED NON-INCENDIVE FIELD WIRING APPARATUS</p> <p>SEAL FITTING</p> <p>CONDUIT OR NON-INCENDIVE FIELD WIRING</p> <p>$V_{oc} \leq 30$ VDC $I_{sc} \leq 140$ mA $P_0 \leq 1W$ $C_A \geq 0.0uF + C$ CABLE $L_A \geq L_i + L$ CABLE</p> <p>$U_i = 30$ VDC $I_i = 140$ mA $C_i = 0$ $L_i = 1W$</p>
<p>NOTES:</p> <ol style="list-style-type: none"> INSTALLATIONS MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE® ANSI/NFPA 70. DUST TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENT. INSTALLATION IN CANADA SHOULD BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE, CSA C22.1, PART 1, APPENDIX F. NO REVISION TO THIS DRAWING IS PERMITTED WITHOUT FM APPROVAL. 		
<p>CERTIFIED by _____ PO # _____ ENG _____ USER _____ DE # _____</p> <p>ISS. EDD/DSR NO. APP# D DATE CK. LEP 5-15-09</p>		<p>COPYRIGHT 2009 AMETEK DREXELBROOK</p> <p>SCALE: NONE UNLESS OTHERWISE STATED ALL DIMENSIONS IN INCHES (IN.)</p> <p>DR. JUS 5-15-09 DR. JUS 5-15-09 DR. JUS 5-15-09</p> <p>205 KELTH VALLEY RD HORSHAM, PA 19044-9986</p> <p>215-674-1234 FAX 215-674-2731</p> <p>FM CONTROL DRAWING U-SONIC 2-WIRE LEVEL CONTROL DIVISION 2 WITHOUT BARRIER. US-1X SERIES</p> <p>420-0004-289-CD</p> <p>SHT 2 OF 3 ISS. 2</p>

7.3 FMc Control Drawings (Continued)

DUST IGNITIONPROOF INSTALLATION	HAZARDOUS (CLASSIFIED) AREA	NON-HAZARDOUS AREA																																				
<p>DIP I₁, II₁..DIV 1, GROUPS E, F, G NI / CL I, II, III...DIV 2...GROUPS A-G</p> <p>②</p> <p>TYPE 4, 4X, IP66</p> <p>AMBIENT TEMPERATURE -25°C.....+70°C</p> <p>MODEL NUMBERS</p> <p>US-1 a</p> <p>q = MOUNTING 1 = 2" NPT 2 = 2" BSP</p>																																						
<p>②</p> <p>NOTES:</p> <ol style="list-style-type: none"> INSTALLATIONS MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE ® ANSI/NFPA 70. DUST TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS I AND CLASS II ENVIRONMENT. INSTALLATION IN CANADA SHOULD BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE, CSA 22.1, PART 1, APPENDIX F. NO REVISION TO THIS DRAWING IS PERMITTED WITHOUT FM APPROVAL. 																																						
<table border="1"> <tr> <td>CERTIFIED</td> <td>by</td> <td>COPYRIGHT 2009</td> <td>FM CONTROL DRAWING</td> </tr> <tr> <td>PO #</td> <td></td> <td>AMETEK DREXELBROOK</td> <td>U-SONIC 2-WIRE LEVEL</td> </tr> <tr> <td>ENG</td> <td></td> <td>SCALE</td> <td>CONTROL DUST IGNITIONPROOF</td> </tr> <tr> <td>USER</td> <td></td> <td>NONE UNLESS OTHERWISE STATED</td> <td>SH 3 OF 3</td> </tr> <tr> <td></td> <td></td> <td>ALL DIMENSIONS IN INCHES (MM)</td> <td>SH. 3 ISS. 3</td> </tr> <tr> <td></td> <td></td> <td></td> <td>OF 3 DF 3</td> </tr> <tr> <td>DE #</td> <td></td> <td>DR. JJS 5-15-09</td> <td>215-674-1234</td> </tr> <tr> <td>ISS. EDD/DSR NO.</td> <td>APP'D</td> <td>DATE</td> <td>FAX 215-674-2731</td> </tr> <tr> <td></td> <td></td> <td>CK. _____</td> <td>420-0004-289-CD</td> </tr> </table>			CERTIFIED	by	COPYRIGHT 2009	FM CONTROL DRAWING	PO #		AMETEK DREXELBROOK	U-SONIC 2-WIRE LEVEL	ENG		SCALE	CONTROL DUST IGNITIONPROOF	USER		NONE UNLESS OTHERWISE STATED	SH 3 OF 3			ALL DIMENSIONS IN INCHES (MM)	SH. 3 ISS. 3				OF 3 DF 3	DE #		DR. JJS 5-15-09	215-674-1234	ISS. EDD/DSR NO.	APP'D	DATE	FAX 215-674-2731			CK. _____	420-0004-289-CD
CERTIFIED	by	COPYRIGHT 2009	FM CONTROL DRAWING																																			
PO #		AMETEK DREXELBROOK	U-SONIC 2-WIRE LEVEL																																			
ENG		SCALE	CONTROL DUST IGNITIONPROOF																																			
USER		NONE UNLESS OTHERWISE STATED	SH 3 OF 3																																			
		ALL DIMENSIONS IN INCHES (MM)	SH. 3 ISS. 3																																			
			OF 3 DF 3																																			
DE #		DR. JJS 5-15-09	215-674-1234																																			
ISS. EDD/DSR NO.	APP'D	DATE	FAX 215-674-2731																																			
		CK. _____	420-0004-289-CD																																			

7.4 ATEX Control Drawings

ENTITY INSTALLATION		HAZARDOUS (CLASSIFIED) AREA		NON-HAZARDOUS AREA	
II 1 G Ex ia IIC T5 NEMKO 05 ATEX 1271X					
AMBIENT TEMPERATURE -40°C...+70°C					
MODEL NUMBERS					
US-2 ^a					
a = MOUNTING					
3 = 2" NPT-EMC					
4 = 2" BSP-EMC					
5 = 2" NPT-EMC-PIPES					
6 = 2" BSP-EMC-PIPES					
UT-21/40224300-004					
2" NPT-EMC-PIPES					
SPECIAL CONDITIONS FOR SAFE USE:					
1. WARNING - POTENTIAL ELECTROSTATIC CHARGING HAZARD. DO NOT RUB WITH A DRY CLOTH.					
2. CARE MUST BE TAKEN WHEN INSTALLING THE ALUMINUM ENCLOSURES THAT EVEN IN THE EVENT OF RARE INCIDENTS AN IGNITION SOURCE DUE TO IMPACT OR FRICTION BETWEEN THE ENCLOSURE AND IRON/STEEL IS EXCLUDED.					
3. THE PROBES OF THE INSTRUMENTS HAVE AN INSULATING PLASTIC SURFACE EXCEEDING MAX ALLOWABLE SURFACE AREA OF 4 cm ² ACCORDING TO EN 50284 AND MORE THAN 20 cm ² ACCORDING TO EN 50014. CARE MUST BE TAKEN TO AVOID STATIC CHARGING OF THE SENSOR BY CONTACT WITH FLOWING MEDIA.					
NOTES:					
1. CONTROL EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 V _{rms} OR V _{dc} .					
2. INSTALLATION SHOULD BE IN ACCORDANCE WITH THE AUTHORITY HAVING JURISDICTION.					
3. THREAD SEALANT MUST BE USED ON NPT THREADS TO MAINTAIN IP68 RATING.					
CERTIFIED	by	6 2-12-108	SGA 3-07-12	COPYRIGHT 2012	AMETEK DREXELBROOK
PO #		5 8-10-105	SGA 8-27-10	SCALE NONE	US/UT-2X SERIES
ENG		4 12-08-101	THP 1-20-09	UNLESS OTHERWISE STATED	CONTROL DRAWING
USER		3 10-07-100	SGA 5-31-08	ALL DIMENSIONS IN INCHES (MM)	2-WIRE LEVEL CONTROL
		2 12-06-113	SGA 12-21-06		ENTITY INSTALLATION, NEMKO
DE #		ISSUED/DSR NO. APP'D DATE	DR. JJS 2-27-12		SHT 1 OF 1 ISS 1
				205 KELTH VALLEY RD	215-674-1234
				HORSHAM, PA 19044-9956	FAX 215-674-2731
				420-0004-312-CD	420-0004-312-CD

TERMS AND CONDITIONS OF SALE



GENERAL: ALL ORDERS ARE SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS. ANY ACCEPTANCE OF ANY OFFER OF BUYER FOR ANY GOODS OR SERVICES IS CONDITIONED UPON THESE TERMS AND CONDITIONS, AND SELLER OBJECTS TO ANY ADDITIONAL OR DIFFERENT TERMS PROPOSED BY BUYER IN ANY DOCUMENT, WHICH SHALL NOT BE BINDING UPON SELLER. No salesman or other party is authorized to bind the AMETEK DREXELBROOK Division of AMETEK, Inc. (hereinafter "Seller") by any agreement, warranty, statement, promise, or understanding not herein expressed, and no modifications shall be binding on Seller unless the same are in writing and signed by an executive officer of Seller or his or her duly authorized representative. Verbal orders shall not be executed until written notification has been received and acknowledged by Seller.

QUOTATIONS: Written quotations are valid for thirty (30) days unless otherwise stated. Verbal quotations expire the same day they are made.

PRICES: All prices and terms are subject to change without notice. Buyer-requested changes to its order ("Orders"), including those affecting the identity, scope and delivery of the goods or services, must be documented in writing and are subject to Seller's prior approval and adjustments in price, schedule and other affected terms and conditions. Orders requiring certified test data in excess of commercial requirements, are subject to a special charge.

ORDER ACCEPTANCE: All Orders are subject to final approval and acceptance by Seller at its office located at 205 Keith Valley Road, Horsham, Pennsylvania 19044.

TERMS OF PAYMENT: Seller's standard terms of payment for Buyers who qualify for credit are net thirty (30) days from date of invoice. All invoices must be paid in United States dollars.

CREDIT: Seller reserves the right at any time to revoke any credit extended to Buyer or otherwise modify terms of payment if Buyer fails to pay for any shipments when due or if in Seller's opinion there is a material adverse change in Buyer's financial condition. Seller may, at its option, cancel any accepted Order if Buyer fails to pay any invoices when due.

DELIVERY: Shipments are F.O.B place of manufacture ("Shipping Point") and the Buyer shall pay all freight, transportation, shipping, duties, fees, handling, insurance, storage, demurrage, or similar charges from Shipping Point. Delivery of goods to common carrier shall constitute delivery and passing of title to the Buyer, and all risk of loss or damage in transit shall be borne by Buyer. Any claims or losses for damage or destruction after such delivery shall be the responsibility of Buyer.

Seller reserves the right to make delivery in installments which shall be separately invoiced and paid for when due, without regard to subsequent deliveries. Delay in delivery of any installment shall not relieve Buyer of its obligation to accept remaining deliveries.

Acknowledged shipping dates are approximate only and based on prompt receipt of all necessary information from Buyer and Buyer's compliance with terms of payment.

TAXES: All sales, excise and similar taxes which Seller may be required to pay or collect with respect to the goods and/or services covered by any Order, shall be for the account of the Buyer except as otherwise provided by law or unless specifically stated otherwise by Seller in writing.

TERMINATION AND HOLD ORDERS: No Order may be terminated by Buyer except upon written request by Buyer and approval by Seller, and if said request is approved by Seller, under the following conditions: (1) Buyer agrees to accept delivery of all of the units completed by Seller through the workday on which Seller receives the written termination request; (2) Buyer agrees to pay to Seller all direct costs and expenses applicable to the portion of the Order that is incomplete.

WARRANTY:

A. **Hardware:** Seller warrants its goods against defects in materials and workmanship under normal use and service for one (1) year from the date of invoice.

B. **Software and Firmware:** Unless otherwise specified, Seller warrants for a period of one (1) year from date of invoice that standard software or firmware, when used with Seller specified hardware, shall perform in accordance with Seller's published specifications. Seller makes no representation or warranty, expressed or implied, that the operation of the software or firmware shall be uninterrupted or error-free, or that functions contained therein shall meet or satisfy the Buyer's intended use or requirements.

C. **Services:** Seller warrants that services, including engineering and custom application, whether provided on a fixed cost or time and material basis, shall be performed in accordance with generally accepted industry practices.

D. **Remedies:** Seller's liability under this section is restricted to replacing, repairing, or issuing credit (at Seller's option) for any returned goods and only under the following conditions: (1) Seller must be promptly notified, in writing, as soon as possible after the defects have been noted by the Buyer, but not later than (1) year from date of invoice from Seller; (2) The defective goods are to be returned to the place of manufacture, shipping charges prepaid by the Buyer; (3) Seller's inspection shall disclose to its satisfaction that the goods were defective in materials or workmanship at the time of shipment; (4) Any warranty service (consisting of time, travel and expenses related to such services) performed other than at Seller's factory, shall be at Buyer's expense.

E. **Repaired/Reconditioned Goods:** As to out-of-warranty goods which Seller has repaired or reconditioned, Seller warrants for a period of sixty (60) days from date of its invoice only new components replaced in the most recent repair/reconditioning.

F. **Returns and Adjustments:** No goods may be returned unless authorized in advance by Seller and then only upon such conditions to which Seller may agree. Buyer must obtain an RMA (Return Material Authorization) number from Seller prior to any return shipment and such RMA number must appear on the shipping label and packing slip. Buyer shall be responsible for the returned goods until such time as Seller receives the same at its plant and for all charges for packing, inspection, shipping, transportation, or insurance associated with returned goods. In the event that credit for returned goods is granted, it shall be at the lesser of the then current prices or the original purchase price. Claims for shortage or incorrect material must be made within five (5) days after receipt of shipment.

ALL OTHER WARRANTIES, FOR ANY OF SELLER'S GOODS OR SERVICES, WHETHER ORAL, WRITTEN, EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE ARE EXCLUDED.

INTELLECTUAL PROPERTY: Seller's sale of goods or provision of related documentation or other materials to Buyer shall not transfer any intellectual property rights to Buyer unless Seller specifically agrees to do so in writing. Seller shall retain ownership of all applicable patents, trademarks, copyrights and other intellectual property rights. Buyer shall not use, copy or transfer any such items in violation of Seller's intellectual property rights or applicable law, or for any purposes other than that for which the items were furnished.

Seller shall defend any lawsuit brought against the Buyer based on a claim that the design or construction of the goods sold hereunder by Seller infringe any United States or Canadian Patent, Copyright or Mask Work Registration, provided that Buyer promptly notifies Seller of such claim in writing and further provided that, at Seller's expense, (1) Buyer gives Seller the sole right to defend or control the defense of the suit or proceeding, including settlement, and (2) Buyer provides all necessary information and assistance for that defense. In the event of a charge of infringement, Seller's obligation under the agreement shall be fulfilled if Seller, at its option and expense, either (i) settles such claim; (ii) procures for Buyer the right to continue using such goods; (iii) replaces or modifies goods to avoid infringement; or (iv) accepts the return of any infringing goods and refunds their purchase price; or (iv) defends against such claim.

If Buyer furnishes specifications or designs to Seller, the obligations of Seller set forth above shall not apply to goods made by Seller using such specifications or designs, and Buyer shall defend, indemnify and hold Seller harmless against any third party claims for infringement which arise out of Seller's use of specifications or designs furnished by Buyer.

SOFTWARE LICENSE: If goods purchased hereunder include software ("Software"), Buyer may use the Software only as part of the goods. Buyer may not use, copy, or transfer any of the Software except as may be permitted under the applicable License Agreement provided with the goods. Buyer's right to use, copy or transfer the Software shall terminate upon termination of Buyer's right to use the goods.

PACKAGING/WEIGHTS AND DIMENSIONS: Buyer specified packing or marking may be subject to additional charges not otherwise included in the price of the goods. Published weights and dimensions are estimates or approximate only and are not warranted.

FORCE MAJEURE: Seller shall not be responsible for delays in delivery or any failure to deliver due to causes beyond Seller's control, including but not limited to the following items: acts of God, war, terrorism, mobilization, civil commotion, riots, embargoes, domestic or foreign governmental regulations or orders, governmental priorities, port congestion, acts of the Buyer, its agents or employees, fires, floods, strikes, lockouts and other labor difficulties, shortages of or inability to obtain shipping space or transportation, inability to secure fuel, supplies or power at current prices or on account of shortages thereof, or due to limitations imposed by the extent of availability of Seller's normal manufacturing facilities.

If a delay excused per the above extends for more than ninety (90) days and the parties have not agreed upon a revised basis for continuing providing the goods or services at the end of the delay, including adjustment of the price, then Buyer, upon thirty (30) days' prior written notice to Seller may terminate the Order with respect to the unexecuted portion of the goods or services, whereupon Buyer shall promptly pay Seller its reasonable termination charges upon submission of Seller's invoices therefor.

LIMITATION OF LIABILITY: Seller's liability for any claim of any kind, except infringement of intellectual property rights, shall not exceed the purchase price of any goods or services which give rise to the claim. **SELLER SHALL IN NO EVENT BE LIABLE FOR BUYER'S MANUFACTURING COSTS, LOST PROFITS, LOSS OF USE OF THE GOODS OR SERVICES, COST OF CAPITAL, COST OF SUBSTITUTE GOODS, FACILITIES, SERVICES OR REPLACEMENT POWER, DOWNTIME COSTS, CLAIMS OF BUYER'S CUSTOMERS FOR DAMAGES, OR OTHER SPECIAL, PROXIMATE, INCIDENTAL, INDIRECT, EXEMPLARY OR CONSEQUENTIAL DAMAGES.** Any action against Seller must be brought within eighteen (18) months after the cause of action accrues. These disclaimers and limitations of liability shall apply regardless of the form of action, whether in contract, tort or otherwise, and further shall extend to the benefit of Seller's vendors, appointed distributors and other authorized resellers as third-party beneficiaries.

PROHIBITION FOR HAZARDOUS USE: Goods sold hereunder generally are not intended for application in and shall not be used by Buyer in the construction or operation of a nuclear installation or in connection with the use or handling of nuclear material, or for any hazardous activity or critical application, where failure of a single component could cause substantial harm to persons or property, unless the goods have been specifically approved for such a use or application. Seller disclaims all liability for any loss or damage resulting from such unauthorized use and Buyer shall defend, indemnify and hold harmless the Seller against any such liability, whether as a result of breach of contract, warranty, tort (regardless of the degree of fault or negligence), strict liability or otherwise.

EXPORT CONTROL: Buyer shall comply with all export control laws and regulations of the United States, and all sales hereunder are subject to those laws and regulations. Seller shall not be named as shipper or exporter of record for any goods sold hereunder unless specifically agreed to in writing by Seller. At Seller's request, Buyer shall furnish Seller with end-use and end-user information to determine export license applicability. Buyer warrants, in accordance with U.S. Export Law, that goods sold hereunder shall not be destined for facilities or activities involving nuclear, chemical or biological weapons, or related missile delivery systems in named prohibited regions or countries.

GOVERNING LAW: Seller intends to comply with all laws applicable to its performance under any order. All matters relating to interpretation and effect of these terms and any authorized changes, modifications or amendments thereto shall be governed by the laws of the Commonwealth of Pennsylvania. No government contract regulations or clauses shall apply to the goods or services, this agreement, or act to bind Seller unless specifically agreed to by Seller in writing.

NON-WAIVER BY SELLER: Waiver by Seller of a breach of any of these terms and conditions shall not be construed as a waiver of any other breach.

SEVERABILITY AND ENTIRE AGREEMENT: If any provision of these terms and conditions is unenforceable, the remaining terms shall nonetheless continue in full force and effect. This writing, together with any other terms and conditions Seller specifically agrees to in writing, constitutes the entire terms and conditions of sale between Buyer and Seller and supercedes any and all prior discussions, and negotiations on its subject matter.



205 Keith Valley Road, Horsham, PA 19044
U.S. and Canada: 1-800-553-9092
24-Hour Service: 1-800-527-6297
International: +1 215-674-1234
Fax: +1 215-674-2731
E-mail: drexelbrook.info@ametek.com
Website: www.drexelbrook.com